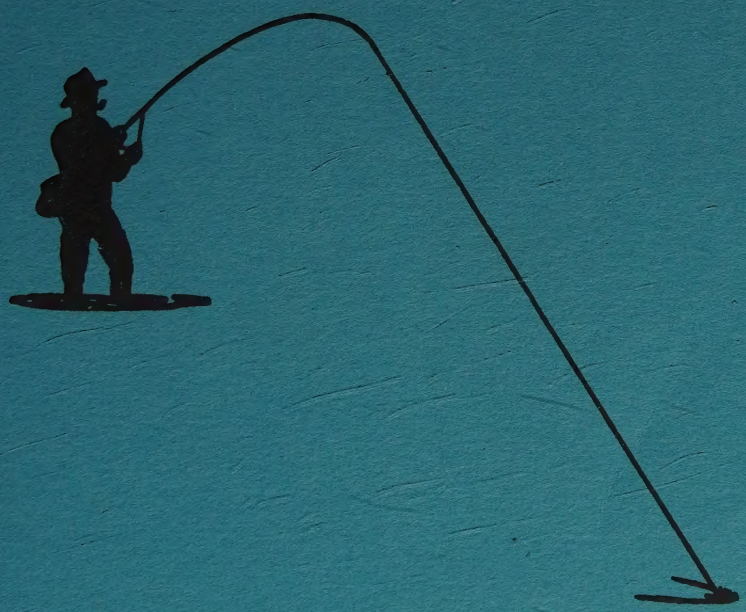
U.S.F.W.S.
6(3)
6(3)
LIBRARY
JAN 12 1962
FISH & WILDLIFE SERVICE

# Sport Fishery Abstracts



**Vol. 6 No. 3**
**Abstracts 4232 - 4437**
**July 1961**

DEPARTMENT OF THE INTERIOR

Stewart L. Udall, *Secretary*

U. S. FISH AND WILDLIFE SERVICE

BUREAU OF SPORT FISHERIES AND WILDLIFE

**Daniel H. Janzen, *Director***

The printing of this publication
was approved by the Director of
the Bureau of the Budget
January 4, 1961

**Washington 25, D. C.**

# Sport Fishery Abstracts

**An abstracting service for fishery research and management**

Vol. 6, No. 3 Abstracts 4232 - 4437 July 1961

Sport Fishery Abstracts is intended to furnish fishery biologists in government agencies and educational institutions with abstracts of the current literature in sport fishery research and management. Abstracts of papers on limnology, ecology, natural history and other fields of specialization will be included when the subject has application to the conservation of sport fish and the restoration of sport fishing.

One volume consisting of not more than four numbers will be issued each year. Each number contains separate Author and Subject indexes, with the final number of each volume containing cumulative indexes.

The last number of each volume contains a list of publications screened for appropriate material. Suggestions for improving the usefulness and coverage of Sport Fishery Abstracts are solicited.

The Bureau of Sport Fisheries and Wildlife of the U. S. Fish and Wildlife Service assumes no responsibility for the accuracy of material from outside sources, and can only supply copies of articles written and published by the U. S. Fish and Wildlife Service. Requests for other articles should be sent to the author or publisher.

---

Prepared in the Branch of Federal Aid
S. E. Jorgensen, Chief
Donald F. LaPointe, Editor
Geneva T. Thompson, Asst. Editor

**4232.** Heard, William R. 1959. THE USE OF HOBBLED GILL NETS IN A COMMERCIAL FISHERY OF LAKE CARL BLACKWELL, OKLAHOMA. Proceedings of the Thirteenth Annual Conference. Southeastern Association of Game and Fish Commissioners. pp. 90-95.

A modified gill net known as a hobbled gill net was utilized in a commercial fishery in 3,300-acre Lake Carl Blackwell in Central Oklahoma from September, 1957 through December, 1958. A total of 3,200 fish weighing 20,252 pounds was taken in 1,085 net days, a net day being 300 feet of net fished 24 hours.

Non-game fishes represented 97 percent by weight of the total catch. Hobbled gill nets proved particularly effective in taking flathead catfish, which comprised 63.4 percent by weight of the total catch. The average catch of flathead catfish increased from 4.9 to 13.0 and 14.6 pounds per net day for 3.0-, 3.5- and 4.0-inch bar mesh nets respectively. In general, the catch of all other species decreased as the mesh size increased from 3 to 4 inches. Hobbled gill nets may be an efficient modification over standard commercial gill nets and a more selective gear for large flathead catfish than other entanglement gears. (Auth. abst.)

**4233.** Stevens, Robert E. 1959. THE WHITE AND CHANNEL CATFISHES OF THE SANTEE-COOPER RESERVOIR AND TAILRACE SANCTUARY. Proceedings of the Thirteenth Annual Conference, Southeastern Association of Game and Fish Commissioners, pp. 203-219.

The reservoir has a surface acreage of 160,500 and contains two rather dissimilar lakes, Lake Moultrie and Lake Marion.

Channel catfish (Ictalurus punctatus) are virtually unknown in Lake Marion, exist in relatively small numbers in Lake Moultrie, and are abundant in the tailrace sanctuary.

White catfish (Ictalurus catus) are present in large numbers in both lakes and the tailrace sanctuary.

The channel catfish of Lake Moultrie and the tailrace sanctuary grow larger and faster, live longer and are in better condition than any channel catfish described in the literature. They, also, differ slightly in morphology. (Auth. abst.)

**4234.** Snow, J. R., and R. O. Jones. 1961. SOME EFFECTS OF LIME APPLICATIONS TO WARM-WATER HATCHERY PONDS. Proceedings of the Thirteenth Annual Conference. Southeastern Association of Game and Fish Commissioners, pp. 95-101.

The results of applying ground limestone ($CaCO_3$), and quicklime (CaO) to hatchery ponds used for the culture of bluegills (Lepomis macrochirus, Raf.) are described. Effects appeared to be beneficial in the sample of ponds treated. Quicklime was difficult to apply because of caustic effects to skin of personnel handling it.

Laboratory experiments indicated that hydrated lime ($Ca(OH)_2$) could be used to produce a pH as alkaline as that obtained from quicklime provided than an equivalent amount of calcium was used in the hydrated form. (Auth. abst.)

**4235.** Scarratt, D. J. 1961. A PRESSURIZING DEVICE FOR A CAMERA CASE DESIGNED FOR USE IN SHALLOW WATER. Journal of the Marine Biological Association of the United Kingdom, Vol. 41, No. 1, pp. 77-80.

A pressurizing device for an underwater camera is described. It consists of a single stage demand-valve working on the same principle as the aqualung, and a Sparklet bulb fitted to the demand-valve by an adaptor and an on/off valve is issued as a gas supply. It permits automatic pressurizing of a camera case with a volume of one l. down to a depth of 30 m, and also permits the pressure to be released as the case is brought to the surface. (Auth. summ.)

**4236.** Sano, Osamu. 1960. THE INVESTIGATION OF SALMON SHARK AS A PREDATOR ON SALMON IN THE NORTH PACIFIC, 1959. Bulletin of the Hokkaido Regional Fisheries Research Laboratory, No. 22, September, 1960, pp. 68-82.

A survey on the predatory activity of salmon sharks on salmon was conducted on a systematic basis for the first time in 1959, in Aleutian waters during the salmon fishing season. Findings in this survey were combined with already known facts to provide biological information on salmon sharks. In the present paper, some aspects are discussed on the biology of the salmon shark.

It was confirmed that salmon sharks migrating round to the Aleutian waters--considering the manner in which they appear as well as their distribution, food habits, etc. --are prey-seeking groups having food chain connections in time and space with the life of salmon over a fairly long period. It was suggested that these vital relations between salmon sharks and salmon have much to do not merely with the fact that the sharks are consuming much salmon similar to the quality of commercial catches but also with the slash marks on the salmon which may have escaped shark's attacks.

In view of the characteristic behavior of salmon sharks in the Aleutian waters, it is now clear that, besides such sea animals as seals and sea lions, salmon sharks as natural enemies of salmon cannot be ignored if the ecology of salmon, whether in feeding migration or spawning migration, is to be correctly understood. In the future, it is essential to continue efforts for the better understanding of the relationship between salmon and its natural enemies and the ecology of the natural enemies themselves in order further to explore the question of the natural mortality of salmon, an important factor affecting the abundance of salmon stock. (Auth. abst.)

**4237.** Yasutake, W. T., D. R. Buhler, and W. E. Shanks. 1961. CHEMOTHERAPY OF HEXAMITIASIS IN FISH. The Journal of Parasitology, Vol. 47, No. 1, pp. 81-86.

Twenty-four chemotherapeutic agents have been

tested for hexamitacidal activity on Hexamita salmonis infections in chinook salmon fingerlings. When supplied at a concentration of 0.2 percent in the diet of the infected fish, p-carbamidophenyl arsenoxide, 2-amino-5-nitrothiazole, PR-3714, or fumagillin were effective in eliminating the parasite without apparent toxic effects to the host. At a 1.0 percent concentration, chlorotetracycline hydrochloride, arthinol, p-carbamidobenzene arsonic acid and 4, 7-phenanthroline-5, 6-quinone were also active.

Calomel, which has been used in the past for treatment of Hexamita salmonis infections, inhibits fish growth at the dosage necessary for therapy. P-carbamidobenzene arsonic acid (carbarsone) was not effective in salmon at the 0.2 percent concentration previously employed for similar infections in trout. (Auth. summ.)

4238. Wolf, Ken, C. E. Dunbar, and E. A. Pyle. 1961. INFECTIOUS PANCREATIC NECROSIS OF TROUT. II. EXPERIMENTAL INFECTIONS WITH BROOK TROUT. Progressive Fish-Culturist, Vol. 23, No. 2, pp. 61-65.

The virus of pancreatic necrosis was propagated in tissue culture and used to infect susceptible brook trout (Salvelinus fontinalis) fry at 4 weeks and at 8 weeks of age. Two separate trials were conducted; and in both the feeding of tissue-culture-propagated virus was followed by the characteristic behavior and symptoms typical of the disease. About one-fourth of the fish died, and histological examination confirmed identification of the disease. The causative agent was reisolated and presumptively identified in tissue culture. In neither trial was the disease found among the unexposed control fish. (Auth. abst.)

4239. Wohlschlag, Donald E. 1961. GROWTH OF AN ANTARCTIC FISH AT FREEZING TEMPERATURES. Copeia, No. 1, pp. 11-18.

To determine the nature of fish growth under almost permanent sea ice cover and at constant freezing temperatures throughout the year, studies were conducted on Trematomus bernacchii, a common nototheniid bottom fish from McMurdo Sound, Antarctica.

Scales from this species have rings which can be interpreted as annuli. It is likely that scales, and hence annuli, are not formed during the first year and until the fish attains a length of around 40 millimeters. Due to the gradual cessation and resumption of summer growth, the last annulus near the outer margin cannot ordinarily be identified. Thus the actual age is most likely the number of annual growth rings observed plus two.

Radii to the various annuli suggest that older and larger fish grow more slowly than the younger and smaller fish (Lee's Phenomenon).

Survival rates tend to decrease with age. Females survive longer than males.

Males and females tend to have uniform morphology with respect to weight-length regressions. For all fish, the regression of weight in grams on total length in millimeters is:

log weight = -5.6519 + 3.3577 log length.

Females tend to be larger than males after both are sexually mature at about five years. There is a suggestion that both the oldest males and females may be some what smaller than those at penultimate ages.

The relatively high growth rate of Trematomus bernacchii at freezing temperatures is discussed with reference to cold adaptation and temperature-metabolism coefficients. (Auth. summ.)

4240. Witt, Arthur, Jr. 1961. AN IMPROVED INSTRUMENT TO SECTION BONES FOR AGE AND GROWTH DETERMINATIONS OF FISH. Progressive Fish-Culturist, Vol. 23, No. 2, pp. 94-96.

An improved instrument designed for the sectioning of bony structures or otoliths in age and growth determinations of fish consists of a fixed saw that can be elevated, a mechanical infeed table that regulates the thickness of sections, and a sliding table with a V-block and clamp attached to hold immovable the structure to be sectioned. The cost of this instrument, including motor, accessories, and construction, is approximately $100. (Auth. abst.)

4241. Wells, Harry W., Mary Jane Wells, and I. E. Gray. 1961. WINTER FISH MORTALITY IN PAMLICO SOUND, NORTH CAROLINA. Ecology, Vol. 42, No. 1, pp. 217-219.

As noted by Winslow (1889), strong northeast winds produce a high wind tide in the southern part of Pamlico Sound. Higher water levels on the sound side of Hatteras and Ocracoke Inlets would prolong the out-flowing phase of the tidal cycle at these inlets and correspondingly shorten the in-flowing phase. Because the chub mackerel is at the southern edge of its range in the Hatteras area, this species would not have been engaged in an active southward migration at the time of the mortality, and there is no indication that the more abundant herring were, either. Presumably, the presence of the affected fish in Pamlico Sound was a consequence of water movement through Oregon Inlet on an unusually large scale.

This mortality evidently resulted from the coincidence of several apparently independent factors: (1) a delayed cooling of sound waters in the fall, (2) a prolonged period of strong northeasterly winds, (3) a movement of temperature-sensitive fish into Pamlico Sound, and (4) a precipitous drop in air temperatures. The probability of having all of these requirements fulfilled and synchronized seems very small. In this connection, it should be noted that local watermen could not recall a similar mass mortality in these sound waters. Evidently, such large-scale winter fish mortalities are a rare occurrence in Pamlico Sound. (From auth. disc.)

4242. Vaux, D., and A. M. Olsen. 1961. USE OF DRIFT BOTTLES IN FISHERIES RESEARCH. Fish. Newslett. Aust., Vol. 20, No. 1, pp. 17-20; C. S. I. R. O. Abstracts, Vol. 9, No. 2, Abst. No. 134. 1961.

The use of drift bottles to study water movements

in shallow seas is described, and details of the drift bottle programme at present being undertaken in Tasmanian and South Australian waters are given.

**4243.** Uchida, Richard N. 1961. HERMAPHRODITIC SKIPJACK. Pacific Science, Vol. XV, No. 2, pp. 294-296.

Descriptions of two hermaphroditic skipjack, Katsuwonus pelamis.

**4244.** Hoffman, Glenn Lyle. 1961. WHIRLING DISEASE (MYXOSPORIDIA: MYXOSOMA) OF TROUT. Fishery Leaflet 508, U.S. Fish & Wild. Serv., 2 pgs.

Identification, cause, source, transmission, incubation period, communicability, susceptibility, range and control are discussed.

**4245.** Tash, Jerry C., and Kenneth B. Armitage. 1960. A SEASONAL SURVEY OF THE VERTICAL MOVEMENTS OF SOME ZOOPLANKTERS IN LEAVENWORTH COUNTY STATE LAKE, KANSAS. The University of Kansas Science Bulletin, Vol. XLI, No. 4.

Quantitative vertical series of plankton samples through nine meters of depth were taken at six-hour intervals during a 24-hour period on June 21-22, August 15-16, and November 22-23, 1958, and March 1-2, 1959, in Leavenworth County State Lake, Kansas.

Data were obtained for nine species of zooplankters, of which Daphnia galeata mendotae, Ceriodaphnia lacustris, Diaphanosoma brachyurum, Bosmina longirostris, Diaptomus pallidus, Mesocyclops edax, and Chaoborus punctipennis showed diurnal migration in at least one sampling period. Chaoborus punctipennis was the only zooplankter that showed diurnal migration all four sampling times. There was no evidence that any crustacean underwent diurnal migration in November, 1958 or March, 1959.

Mesocyclops edax, present in June, August, and November, 1958, was replaced in March, 1959, by Cyclops bicuspidatus.

Light, overturn, size, thermocline, and gravity were important factors that seemed to affect the vertical distribution and migration of the zooplankters; factors of lesser importance were sex, temperature and oxygen. The daily and seasonal changes in vertical distribution and patterns of migration were probably the result of different combinations of these modifying factors. (Auth. summ.)

**4246.** Tanoue, Toyotake. 1960. STUDIES ON THE RELATION BETWEEN THE FLUCTUATION IN CATCH AND THE ENVIRONMENTAL FACTORS OF THE PRINCIPAL FISHES IN KAGOSHIMA BAY. -- IV. ON THE YOUNG HORSE-MACKEREL, TRACHURUS JAPONICUS. Memoirs of the Faculty of Fisheries Kagoshima University, Vol. 9, pp. 54-60.

Fluctuation in the catch of young horse-mackerels in Kagoshima Bay has been studied through a survey of statistical data on the catch at twenty fishing ports on the coast of the bay. Young fish are chiefly caught in the waters where the depth ranges from 30 to 50 m. In the inside of the bay the fishing is principally performed during the months from April to October, while fishing season at the entrance of the bay is mainly confined to a period from November to March.

The distribution of body-lengths in the catch was studied monthly between March and December, 1959. The great majority of the catch is occupied by small-sized (6-14 cm in the body length) individuals, a small portion consisting of large-sized (15-21 cm in the body-length) animals. Referring also to the culture experiment of young fish, it is postulated that the above stated small-sized fish are in their first year and the large-sized animals are in their second year.

The migration of young horse-mackerels into the bay takes place in spring, most probably when a water temperature at 25 m depth is raised over 17° C; the migration to the outside of the bay seems to occur in autumn with the lowering of the water temperature. (Auth. abst.)

**4247.** Sheridan, William L. 1961. TEMPERATURE RELATIONSHIPS IN A PINK SALMON STREAM IN ALASKA. Ecology, Vol. 42, No. 1, pp. 91-98.

Although the extent of relationship between temperatures of the various media varied with the season, air temperatures were found to dominate and govern all water temperatures during a large part of the climatic year.

Winter stream temperatures depend to a large extent on whether the stream is covered with ice and snow. If the stream is clear of ice, stream temperatures are usually higher than when the stream is covered. If the stream is covered, temperatures in the stream are less influenced by air temperatures. The protective influence of an ice and snow layer was evident in Cabin Creek during one of the coldest winters on record.

In the spring, melting snow subdues the effect of high air temperatures on water temperatures. Variable yearly water temperatures in the spring, caused by an interaction of air temperatures and accumulated snow, can influence the number of temperature units available to developing pink salmon larvae, hence may cause fry to migrate to sea at unfavorable times.

Temperature gradation was more pronounced in groundwater of the banks than in water within the gravel of the streambed, and was more marked in the intertidal zone than in the stream above tidal influence. In the intertidal zone, temperature gradation was the result of the ebb and flow of warmer salt water over the area. Temperature changes in the intertidal zone depend mainly on tide level, temperatures of stream and salt water, and permeability of streambed gravels.

Salt water bathing intertidal zones may give salmon eggs and larva protection against freezing during extremely cold winters and may accelerate developmental rate because of higher temperatures than in the stream above the tides. Pink salmon

eggs reared in dilute salt water also have a higher survival than eggs reared in freshwater controls. (From auth. summ.)

**4248.** Schwartz, Frank Joseph. 1960. BIBLIOGRAPHY OF MARYLAND FISHERIES, INCLUDING PUBLISHED AND UNPUBLISHED PAPERS ON THE FISHERIES AND RELATED FIELDS OF TIDEWATER MARYLAND. Maryland Board of Natural Resources, Department of Research and Education, Contribution No. 144, Chesapeake Biological Laboratory, 35 pgs.

**4249.** Robertson, O. H. 1961. PROLONGATION OF THE LIFE SPAN OF KOKANEE SALMON (ONCORHYNCHUS NERKA KENNERLYI) BY CASTRATION BEFORE BEGINNING OF GONAD DEVELOPMENT. Proceedings of the National Academy of Sciences of the United States of America, Vol. 47, No. 4, pp. 609-621.

To ascertain whether or not there is a causal relationship between the spawning act and subsequent death of Pacific salmon, a large number of kokanee salmon (168) were castrated at 2 years of age while still completely immature. They were maintained in a rearing pond together with twice the number of unoperated controls. The castrates grew well and were indistinguishable from the controls until the fourth year when many of the males took on the morphological appearance of normally maturing salmon, exhibited degenerative changes and died. Regeneration of testicular tissue, usually very small in amount, was found to be present in these fish. The control kokanee all matured and died before the end of their fifth year. A small group of castrates (21) were alive at this time, and continued to grow. Seven of them reached the eighth year of life and two survived until the ninth year. The last, a female, died at 8 years 6 months. The results of this experiment indicate that it is the maturation of gonadal tissue and not the actual spawning (at least in males) which leads to degeneration and death and that if sexual development is prevented by castration kokanee can survive well beyond the normal life span of this species. (Auth. summ.)

**4250.** Randall, John E. 1961. A CONTRIBUTION TO THE BIOLOGY OF THE CONVICT SURGEONFISH OF THE HAWAIIAN ISLAND, ACANTHURUS TRIOSTEGUS SANDVICENSIS. Pacific Science, Vol. XV, No. 2, pp. 215-272.

A comprehensive life history study.

**4251.** Radovich, John. 1961. RELATIONSHIPS OF SOME MARINE ORGANISMS OF THE NORTHEAST PACIFIC TO WATER TEMPERATURES, PARTICULARLY DURING 1957 THROUGH 1959. State of California Department of Fish and Game Marine Resources Operations, Fish Bulletin No. 112. 62 pages.

After nine consecutive years of subnormal temperatures, the ocean off the Pacific Coast of North America warmed up in 1957, heralding the beginning of a warm period which continued at least through 1959. Concurrently, many southern marine species wandered north of their usual range and some warm-water forms spawned successfully off southern California. An analysis of past records showed similar intrusions of southern species during previous warm-water years.

In addition to fish moving northward during 1957, 1958 and 1959, some rare species were caught which showed no latitudinal movement, and some were collected south of their usual ranges. However, even some of these may have resulted from oceanic changes taking place during this period.

Other vertebrates, including whales and birds, many invertebrates, and some marine plants were affected in one way or another by the change. The northward distribution of some invertebrates seemed more closely related to the development of the countercurrent than to the increase in temperature. (Auth. abst.)

**4252.** Reish, Donald J. 1961. A STUDY OF BENTHIC FAUNA IN A RECENTLY CONSTRUCTED BOAT HARBOR IN SOUTHERN CALIFORNIA. Ecology, Vol. 42, No. 1, pp. 84-91.

A periodic quantitative study was made in a newly dredged marine boat harbor to determine whether or not the subtidal benthic fauna succession occurred on the bottom.

Polychaetes comprised 60% of the species and 87% of the specimens collected. Molluscans, crustaceans, and nemerteans were the other important groups taken.

A peak in the number of species and specimens was reached about 2 years after sea water was first let in. The population decreased markedly in the ensuing year. Various explanations for this reduction in the number of species and specimens are discussed.

The principal bottom-dwelling species in Alamitos Bay Marina include 11 species of polychaetes, unidentified nemerteans, and one species of pelecypod. The occurrence, abundance, and ecology of these species are discussed.

There was no evidence of succession in Alamitos Bay Marina. The principal species were dominant during the entire period of study. The bottom fauna was compared with the other portions of Alamitos Bay, Lower Newport Bay, and outer Los Angeles-Long Beach Harbors. In general, the faunas of all regions were similar. The polychaete Cossura candida was only encountered sparingly in the marina, but this species constitutes an important element of the benthic fauna in the other areas. (Auth. summ.)

**4253.** Phillips, Arthur M., Jr. 1961. EFFECT OF WATER TEMPERATURE AND DIET ON THE BLOOD GLUCOSE OF BROOK TROUT. Prog. Fish-Cult., Vol. 23, No. 2, pp. 66-69.

Normal activity and water temperature failed to alter the blood glucose of brook water over a 12-hour experimental period. High dietary carbohydrate increased the blood glucose of the fish, and the increased level was maintained continuously as long as the high carbohydrate diet was fed. It is speculative

whether the high blood-glucose levels occurring in all hatchery trout fed meat-meal diets containing fairly high levels of carbohydrates are desirable. Blood glucose was not found to be a valid measure of changes in general metabolism of trout. (Auth. abst.)

**4254.** Pimentel, David. 1961. ANIMAL POPULATION REGULATION BY THE GENETIC FEED-BACK MECHANISM. The American Naturalist, Vol. XCV, No. 881, pp. 65-79.

That a genetic feed-back mechanism functions to regulate populations of herbivores, parasites, and predators is supported by evidence from the biomathematics of population dynamics and studies of natural populations. The mechanism functions as a feed-back system through the dynamics of density pressure, selective pressure, and genetic changes in interacting populations. In a herbivore-plant system, animal density influences selective pressure on plants; this selection influences genetic make-up of plant; and in turn, the genetic make-up of plant influences animal density. The actions and reactions of interacting populations in the food chain cycling in the genetic feed-back mechanism result in the evolution and regulation of animal populations. (Auth. summ.)

**4255.** Perlmutter, Alfred. 1951. POSSIBLE EFFECT OF LETHAL VISIBLE LIGHT ON YEAR-CLASS FLUCTUATIONS OF AQUATIC ANIMALS. Science, Vol. 133, No. 3458, pp. 1081-1082.

Visible light killed the eggs and developing embryos of brook and rainbow trout. It is hypothesized that light could kill the eggs and embryos of all aquatic vertebrates and invertebrates. Adaptations minimize but do not completely block this lethal effect. Under some circumstances, visible light could cause heavy mortality in a new year-class of an aquatic animal. (Auth. abst.)

**4256.** O'Rourke, Fergus J. 1961. PRESENCE OF BLOOD ANTIGENS IN FISH MUCUS AND ITS POSSIBLE PARASITOLOGICAL SIGNIFICANCE. Nature, A Weekly Journal of Science, Vol. 189, No. 4768, p. 943.

Some of the serum protein antigens of fishes are also secreted in mucus. These species-specific antigens may be responsible, in part at least, for the ability of certain fish parasites to detect their specific hosts. Wright has pointed out that parasites must detect their hosts by chemotactic methods, and the presence of species-specific serum proteins in the body mucus suggests a possible basis for this.

**4257.** Oliva, Ota. 1960. FURTHER CONTRIBUTION TO THE FISH POPULATIONS COMPOSITION IN MIDDLE BOHEMIA. (DALSI PRISPEVEK K POZNANI SLOZENI RYBICH POPULAEI V POLABI.) Vestnik Ceskoslovenske Spolecnosti Zoologicke, Vol. XXIV, No. 1, pp. 42-49.

In the summer 1955 the pool "Poltruba", water surface area 1804 $m^2$, average depth 2.7 m., maximum depth 6 m was poisoned with rotenone, all dead fishes found counted and weighed. Nineteen species were found. During the high water in winter 1956 some fishes entered the pool and spawned. It was necessary to keep the pool without fishes for experimental purposes. Therefore in the summer of 1956 a new poisoning with rotenone ("Fish Tox") was undertaken and all fishes killed. Beside these fishes about 153-164, 000 young fingerlings of various Cyprinids could be estimated in the pool. It is evident, the problem of fish management is not in planting of Cyprinids, but in permanent control of their number and specific composition. (Auth. summ.)

**4258.** Nigrelli, Ross F., and Sophie Jakowska. 1961. FATTY DEGENERATION, REGENERATIVE HYPERPLASIA AND NEOPLASIA IN THE LIVERS OF RAINBOW TROUT, SALMO GAIRDNERI. Zoologica, Sci. Cont. N. Y. Zool. Soc., Vol. 46, Nos. 1-4, pp. 49-55.

Microscopical findings in livers of more than 300 hatchery-raised rainbow trout from several states and from rainbow and brown trout from natural streams are described. Most of the livers resembled those of fish kept in captivity and fed artificial diets for prolonged periods. The lesions, when present, were mainly degenerative and characterized by fatty infiltration, glycogen depletion or infiltration, ceroid deposition, hematochromatosis, focal necrosis with lymphocytic infiltration, biliary and portal cirrhosis and other histological and cytological changes. These conditions were associated with compensatory non-nodular and nodular hyperplasia of the liver cells, and it is assumed that under certain circumstances hyperplasia is supervened by neoplasia. Hereditary, nutritional carcinogenic and other possible etiological factors are discussed. (Auth. summ.)

**4259.** Muller, W. 1960. UNTERSUCHUNGEN UBER DIE MACHWIRKUNG EINER IM VORJAHN GEGEBENEN PHOSPHATDUNGUNG IN TEICHEN. Zeitschrift Fur Fischerei Und Deren Hilfswissenschaften, Vol. IX, Nos. 5, 6, pp. 321-331.

The after effect of a phosphate application (70 kg $P_2O_5$ per ha) from the preceding year was studied in a pond experiment with 2-year-old carps. Contrary to the results of the experimental pond station at Wielenbach the ponds fertilized with phosphate in the preceding year showed under our conditions only an unimportant surplus increment as against the unfertilized ponds. The after-effect was not statistically significant. Chemical investigations of pond soil samples yielded no definite dependency of the phosphate content on a previous P-application. There was likewise no general correlation between $P_2O_5$-content of the soil and fish increment. The surplus increment due to a higher $P_2O_5$- content of the soil was found as highly significant only in directly neighboring ponds. The phosphate content of the pond soil was so high that in case of favourable conditions more $P_2O_5$ may be dissolved than by normal fertilizing. There was a strong correlation between the iron content of the pond soils and the phosphate content. (Auth. summ.)

**4260.** Moav, Rom. 1960. AN ELECTRIC INSTRUMENT FOR BRANDMARKING FISH. Bamidgeh, Vol. 12, No. 4, pp. 92-95.

In breeding experiments with carp, it has been found necessary to mark thousands of fish. Tagging with Atkins tags was found unsatisfactory, since the wounds caused by tagging did not heal, the rate of growth of the tagged fish was slower than that of the untagged, and many tags were lost during the growing season. Branding on the other hand was found to be a satisfactory marking method. The wounds heal quickly, there is no adverse effect on the rate of growth, and the brand mark may as a rule be distinguished clearly at the end of the growing season. (Auth. intro.)

**4261.** McNaught, Donald C., and Arthur D. Hasler. 1961. SURFACE SCHOOLING AND FEEDING BEHAVIOR IN THE WHITE BASS, ROCCUS CHRYSOPS (RAFINESQUE), IN LAKE MENDOTA. Limnology and Oceanography, Vol. 6, No. 1, pp. 53-60.

Zooplankters of the genus Daphnia comprise the bulk of the food of the white bass, Roccus chrysops in Lake Mendota, Wisconsin. Compact schools of white bass are conspicuous at the surface from May through October. Planktonic Daphnia are highly aggregated, on a relatively small scale in foamlines or roll vortices, and on a larger scale by horizontal convergence on the leeward side of important shoal areas. The white bass are able to locate regions of high concentrations of air-locked and/or free-swimming Daphnia, as shown by highly significant differences between the mean numbers of organisms found within and outside of feeding areas. Suggestions are made as to the mechanisms involved. The relatively limited but significant vertical migration of Daphnia in Lake Mendota consists of typical morning and evening maxima at the surface. The pattern of feeding activity of the white bass is shown to correspond with the morning and evening concentrations of Daphnia in the surface waters. Some effects of the feeding behavior upon the efficiency of food-intake are discussed. (Auth. abst.)

**4262.** McCrimmon, H. R., and A. H. Berst. 1961. AN ANALYSIS OF SIXTY-FIVE YEARS OF FISHING IN A TROUT POND UNIT. The Journal of Wildlife Management, Vol. 25, No. 2, pp. 168-178.

A study has been made of the trout fishery of a private three-pond fishing unit of 5.1 a. for which annual stocking and harvest records are available from 1895 to 1959. During this period 65,710 fish were harvested by angling, representing a relatively stable annual harvest averaging 1,027 trout. Frequent plantings in the ponds totalled 239,650 fry, fingerling, yearling, and 2-year-old speckled trout between 1895 and 1956. The absence of plantings in the ponds in recent years has shown no adverse effect on numbers of trout harvested.

An analysis of more detailed statistics has been made on the fishery from 1955 to 1959, when 14,778 trout of all sizes were caught by 3,007 hours of angling. Of this catch, 5,714 "legal-sized" trout, averaging 0.22 lb. each, were harvested at a rate of 1.7 fish per man-hour. The average annual harvest rate was 231 fish or 54.2 lb. of trout per acre. During the 5-yr. period there has been a gradual decline in the annual harvest from 2.5 to 1.5 trout per man-hour although the catch of fish of all sizes has remained relatively constant, averaging 4.3 trout per man-hour. Few trout live in the ponds beyond the 4th year of life. (Auth. summ.)

**4263.** Markowski, S. 1960. OBSERVATIONS ON THE RESPONSE OF SOME BENTHONIC ORGANISMS TO POWER STATION COOLING WATER. The Journal of Animal Ecology, Vol. 29, No. 2, pp. 349-357.

A year's observations were made on the settling of benthonic organisms on experimental slabs placed in the intake and in the outfall water of the power station. No growth of algae was found in the intake, but there was very prolific growth in the outfall. No difference in the specific composition of benthonic invertebrates was found between the intake and the outfall slabs. It is supposed that the outfall area is beneficial in some respect as the benthonic forms appear earlier than in the intake.

The general characteristic of the environment, and the factors introduced by the power station into the aquatic medium are given. (Auth. summ.)

**4264.** Lotan, Ruth. 1960. ADAPTABILITY OF TILAPIA NILOTICA TO VARIOUS SALINE CONDITIONS. Bamidgeh, Vol. 12, No. 4, pp. 96-100.

The survival potential of T. nilotica at various salt concentrations in direct transferral and in gradual adaptation was investigated.

Maximum salt concentration tolerated on direct transferral is between 60-70% sea water (2.2-2.5% NaCl).

Through gradual adaptation, the fish can withstand salinity up to 5.35% NaCl (150% sea water).

With increasing salinity, the osmotic pressure of the fish rises from 1.06% NaCl (value found in fresh water fish) to 1.3% NaCl (slightly higher than in sea fish. The osmotic pressure rises with the surroundings up to 1.57% NaCl; only above 70% sea water does the osmoregulatory mechanism operate to reduce osmotic pressure to 1.3% NaCl value. (Auth. summ.)

**4265.** Lennon, Robert E. 1961. A FLY-ROD ELECTRODE SYSTEM FOR ELECTROFISHING. Progressive Fish-Culturist, Vol. 23, No. 2, pp. 92-93.

An alternate-polarity electrode system attached to a section of glass fly rod is described. This system is powered by 115 or 230 volts, AC, and is manipulated by one man. The operator wades the streams and casts the electrodes as one would cast a fishing line. Applications were made on small and remote trout streams. (Auth. abst.)

**4266.** Kawamoto, N. Y. 1961. THE INFLUENCE OF EXCRETORY SUBSTANCES OF FISHES ON THEIR OWN GROWTH. Progressive Fish-Culturist, Vol. 23,

No. 2, pp. 70-75.

Laboratory experiments were made to determine how the growth of carp is influenced by metabolic waste accumulations. Solutions of ammonium chloride largely inhibited the growth of carp, though these fish had more ability to resist the effects of ammonia than trout. Comparison of respiration in 1.2 ppm ammonium chloride and in normal water showed that oxygen consumption of carp in the ammonia solution decreased at low temperatures but increased at high temperatures. In a study of excretions of goldfish, ammonia in the urine excreted by goldfish weighing 2,516 grams was calculated to reach 36.49 grams in 2 months, while total nitrogen in dried feces was determined to be 5.78 percent. Decomposition of the feces--containing microalgae, protozoa, and other material--would result in the release of additional ammonia. (Auth. abst.)

**4267.** Kuehne, Robert A., and Reeve M. Bailey. 1961. STREAM CAPTURE AND THE DISTRIBUTION OF THE PERCID FISH ETHEOSTOMA SAGITTA, WITH GEOLOGIC AND TAXONOMIC CONSIDERATIONS. Copeia, No. 1, pp. 1-8.

The Etheostoma sagitta species group consists of two species and three forms; it is referred to the subgenus Oligocephalus. The distinguishing characters of the three forms are presented in tables of variation and in a key, and their distribution records are listed and mapped. Etheostoma nianguae is distinctive morphologically and is confined to the lower Osage River system in Missouri. Etheostoma sagitta consists of two subspecies, E. s. sagitta, an endemic form of the upper Cumberland basin, and E. s. spilotum of the upper Kentucky drainage. These subspecies overlap only slightly in scale counts, but appear to be indistinguishable otherwise.

Investigation of the topography of the watershed between the Cumberland and Kentucky rivers reveals a near-classical example of stream piracy between the drainages. Geologic and ichthyofaunal evidence indicates that piracy of upper Collins Fork as well as dispersal of the indicator fish species was from the Cumberland basin to the Kentucky system. The differentiation of Etheostoma sagitta spilotum from E. sagitta sagitta dates from the time of the stream capture, as yet unknown. In addition to E. sagitta, another darter, E. Ulocentra sp., gained access to the Kentucky River system as a result of the stream capture. (Auth. summ.)

**4268.** Kodama, Yasuo. 1960. STUDIES ON THE SPECIFIC GROWTH OF FRESHWATER FISHES REFERRING TO THE WEIGHT INCREASE OF INDIVIDUAL AND POPULATION--III. GROWTH OF THE POND-REARED AYU-FISH, PLECOGLOSSUS ALTIVELIS T. and S., WITH SPECIAL REFERENCE TO THE SIGNIFICANCE OF THEIR SOCIAL BEHAVIOUR IN ELIMINATING THE POSSIBLE GROWTH-IMPROVING EFFECT OF FEEDING BY MANY FOOD-BALLS. Bull of Freshwater Fisheries Research Lab., Vol. 10, No. 2, pp. 23-40.

In a part of study to analyze the relation between stocking rate and growth of ayu-fish with special reference to the social behaviour shown by them, 3 groups of fish have been reared in rate of 60 fish in pond of 3.6 $m^2$ in area giving 1 (group A), 4 (B) and 8 (C) food-balls at every feeding time. Other conditions, including total amount of food given to them, were not varied among the three groups.

Variation of growth rate within group, size-hierarchy in growth, increase in total weight of fish, and amount of food taken by fish in the period were examined in each group but all of these did not show significant differences among the groups. Size-dependent, season, and social-inhibiting factors which influence the growth rate were distinguished in the course of analysis of growth of smaller-sized fish. These findings were also common among all the experimental groups.

Results of the behavioristic study showed that school-fish in groups being fed by many food-balls could not eat the food-balls included within any range of territory each of which was defended by one particular fish.

Accordingly, increased number of food-balls could not be said to play a part in improving growth of ayu-fish owing to the stereotypical pattern of social behaviour shown by fish in population. This would prove an extraordinarily important role played by social behaviour in the mechanics of growth and production of ayu-fish. (Auth. summ.)

**4269.** Klawe, W. L. 1961. YOUNG SCOMBROIDS FROM THE WATERS BETWEEN CAPE HATTERAS AND BAHAMA ISLANDS. Bull. of Marine Science of the Gulf and Caribbean, Vol. 11, No. 1, pp. 150-157.

A collection of young scombroid fishes made by the United States Fish and Wildlife Service in 1953 and 1954 in the waters between Cape Hatteras and the Bahama Islands contained 50 specimens. These fish are either from stomachs of six species of pelagic fishes or from collections made with dipnets. The following genera and species were represented: (1) Thunnus atlanticus, (2) Katsuwonus pelamis, (3) Euthynnus alletteratus, (4) Auxis thazard, (5) Sarda sarda (6) Thunnus sp. indet., and (7) Scomberomorus sp. indet. It is inferred that the time of spawning of the various species of scombroids from that area conforms with the time of spawning in the southern portion of the Florida Current and in the Gulf of Mexico. (Auth. abst.)

**4270.** Johnson, A. K. 1961. ICHTHYOPHTHIRIASIS IN A RECIRCULATING CLOSED-WATER HATCHERY. Progressive Fish-Culturist, Vol. 34, No. 2, pp. 79-82.

A severe epidemic of Ichthyophthirius multifiliis in the Humboldt State College Fish Hatchery was successfully controlled with treatments of 0.25 percent salt and 1:800,000 malachite green (chloride) solution. Thirty-minute treatments were administered twice a day for 11 days in water temperatures ranging from 62° to 66° F. During this period there was no loss among the yearling rainbow (Salmo gairdneri) and cutthroat (S. clarki clarki) brood stocks. A high mortality rate which had been occurring in the heavily

infested lots of silver salmon (Oncorhynchus kisutch) and steelhead (S. gairdneri) fingerlings decreased and became negligible in later stages of treatment. (Auth. abst.)

**4271.** Hennemuth, Richard C. 1961. SIZE AND YEAR CLASS COMPOSITION OF CATCH, AGE AND GROWTH OF YELLOWFIN TUNA IN THE EASTERN TROPICAL PACIFIC OCEAN FOR THE YEARS 1954-1958. Inter-American Tropical Tuna Commission Bulletin, Vol. V, No. 1, 112 pgs.

Data on the size composition of catch for the years 1954-1958 have been studied to determine year class composition, age and growth of yellowfin tuna in the Eastern Tropical Pacific Ocean. Direct age determination of tropical tunas has not yet proven reliable; however, this analysis has shown that the length-frequency distributions themselves are adequate to determine year class structure and growth rates. Absolute age has been estimated by comparing the average time of spawning with the time at which age groups initially appear in the catch.

A minimum legal limit of 55 cm. (7.5 lbs.) controls the size at which age groups first enter the catch; at which time they are approximately 12 months old. Fishing selectivity causes the modal size of age groups to be much overestimated, however, during the first few months in the exploited phase. At an age of two years, yellowfin average 85 cm. (28 lbs.), at three years 123 cm. (84 lbs.) and at four years 144 cm. (134 lbs.). There are relatively few fish in the catch that are older than four years.

Growth rate is similar throughout the Eastern Pacific fishing grounds; however, some variability in time of spawning is indicated among the populations supporting the fisheries in the Northern, Central and Southern Regions, indicating some degree of autonomy.

Growth rate of yellowfin in the Eastern Pacific is comparable to that in the Central and Western Pacific. (Auth. summ.)

**4272.** Hartman, Richard T., and Craig L. Himes. 1961. PHYTOPLANKTON FROM PYMATUNING RESERVOIR IN DOWNSTREAM AREAS OF THE SHENANGO RIVER. Ecology, Vol. 42, No. 1, pp. 180-183.

The effect of phytoplankton from highly productive Pymatuning Reservoir on its drainage outlet, the Shenango River, was studied during the summer at 6 collecting stations covering a downstream distance of 10.57 miles.

The phytoplankton of the upper Shenango River is typical of that found in the Pymatuning Reservoir.

An average decrease in numbers of cells of 72.6% was found between the reservoir and the last collecting station.

The proportion of diatoms in the community generally increased at downstream stations.

Rapid current and high silt content of the river were considered important factors in decrease in numbers of organisms.

Phytoplankton from Pymatuning Reservoir exists in downstream areas in high enough concentrations to suggest potential problems for water users. There is need for consideration and appraisal of the creation of such conditions prior to the construction of new impoundments. (Auth. summ.)

**4273.** Flora, Charles J. 1951. THE SPECIES COMMONALITY INDEX: A METHOD FOR COMPARING HABITATS. Pacific Science, Vol. XV, No. 2, pp. 307-308.

The number of faunal species common to both habitats is divided by the total number of species in the two habitats to arrive at a commonality index. Collections should be complete and made as concurrently as possible. The method should be applied only within limited biological or geographical areas where biotic exchange is possible or likely. Examples are given.

**4274.** Courtenay, Walter R., Jr. 1961. WESTERN ATLANTIC FISHES OF THE GENUS HAEMULON (POMADASYIDAE): SYSTEMATIC STATUS AND JUVENILE PIGMENTATION. Bull. of Marine Science of the Gulf and Caribbean, Vol. 11, No. 1, pp. 66-149.

Thirteen species of the genus Haemulon Cuvier from the western Atlantic are described, illustrated and discussed and keys presented for determination of adult and juvenile forms. Particular attention is paid to juvenile pigmentation with regard to identification. The genera Brachygenys Scudder and Bathystoma Scudder are synonymized with Haemulon.

Eleven species of the genus occur throughout the Caribbean including southern Florida. Haemulon bonariense Cuvier is restricted to the West Indies and Haemulon steindachneri (Jordan and Gilbert) to the northern coast of South America and the eastern Pacific. Haemulon schranki Agassiz may not be identified with any known species of the genus at the present time. (Auth. abst.)

**4275.** Colebrook, J. M. 1960. PLANKTON AND WATER MOVEMENTS IN WINDERMERE. The Journal of Animal Ecology, Vol. 29, No. 2, pp. 217-240.

A continuous horizontal plankton sampler and a vertical closing net were used for making collections of the zooplankton of the north basin of Windermere. The horizontal sampler was carried in a motor launch and consisted of a pump and hose, collecting continuously at a depth of 4.5 m, and two filter chambers, which were operated alternately at regular intervals as the launch travelled through the water.

Temperature and wind data were used to assess the nature of the water movements at the times of the collections. It is concluded that the horizontal distribution of the zooplankton is determined to a large extent by the water movements.

A theoretical consideration of the effects of water movements in a stratified lake on the horizontal distribution of zooplankton indicates that an internal seiche should have a temporary effect on the distribution, while the effect of wind and of an internal seiche combined with diurnal vertical migration through the thermocline should have a permanent effect on the

horizontal distribution.

An approximate equation describing the horizontal distribution of zooplankton during an internal seiche is derived. This equation is used to show that certain statistical properties of the observed distributions may be determined by the effects of water movements.

It is considered that the principles of the control of the horizontal distribution of zooplankton by water movements should apply to all thermally stratified lakes, but that in lakes much larger than Windermere these effects may not be very great and may be obscured by other factors.

Several methods of census sampling of the zooplankton of Windermere are described, all of them rather complicated and laborious. A method which should yield reasonable estimates for not too much labour is to take a fairly small number of bottom to surface vertical hauls at different stations and to extrapolate from there, using the results of a continuous horizontal collection taken at night and covering as much of the area of the lake as possible. (Auth. summ.)

**4276.** Carpelan, Lars H. 1961. SALINITY TOLERANCES OF SOME FISHES OF A SOUTHERN CALIFORNIA COASTAL LAGOON. Copeia, No. 1, pp. 32-39.

A coastal lagoon, which was open to the ocean during the first six months of a period of observation and sampling, was closed off during the following eight months of study. Salinity increased from 35 °/oo to over 60 °/oo. Compared to conditions present while the lagoon was open to the ocean, after the closing of the bar summer water temperatures were 4-5° C. higher, the pH was generally 0.6 to 1.0 pH unit higher, and the concentrations of dissolved oxygen were slightly lower. However, since both pH and dissolved oxygen had been as variable prior to closing of the lagoon as afterward, the main physical factors of concern were temperature and salinity, of which the latter showed the greater change.

Of 10 species of fish trapped in the lagoon when it closed, the majority tolerated the changing conditions until the salinity reached 50-55 °/oo. Hypsopetta guttulata withstood the conditions a little longer--until the salinity was 55-60 °/oo. No upper limit of tolerance was observed for Fundulus parvipinnis and Girella nigricans, nor for Atherinops affinis littoralis, some which were thriving, at a salinity of 63°/oo, when the study terminated. (Auth. summ.)

**4277.** Bearden, Charles M. 1961. LIST OF MARINE FISHES RECORDED FROM SOUTH CAROLINA. Bears Bluff Laboratories, Wadmalaw Island, S. C., 12 pgs.

A partial list of marine fishes of South Carolina.

**4278.** Buss, Keen, and Dixon Waite. 1961. RESEARCH UNITS FOR EGG INCUBATION AND FINGERLING REARING IN FISH HATCHERIES AND LABORATORIES. Progressive Fish-Culturist Vol. 23, No. 2, pp. 83-86.

The description and operation of research units for hatcheries and laboratories are presented. These units are compact, and many replications of experiments in egg incubation and fingerling rearing can be conducted in a limited space with a comparatively small water supply. Most of the study dealt with trout eggs, but preliminary investigations indicate that these units may also be applicable for research on warm-water fishes. (Auth. abst.)

**4279.** Braem, Robert A. 1961. A BACK-PACK SHOCKER FOR COLLECTING LAMPREY AMMOCOETES. Progressive Fish Culturist, Vol. 23, No. 2, pp. 87-91.

The use of specific larvicides to control the sea lamprey required intensive surveys to determine distribution of ammocoetes. To facilitate the field work, a battery-powered shocker weighing approximately 25 pounds was designed. As the necessarily limited weight of the battery limited the ampere-hour rating, a charging circuit in the survey vehicle was designed for use in the field. (Auth. abst.)

**4280.** Baslow, Morris H., and Ross F. Nigrelli. 1961. MUSCLE ACETYLCHOLINESTERASE LEVELS AS AN INDEX OF GENERAL ACTIVITY IN FISHES. Copeia, No. 1, pp. 8-11.

Differences in the acetylcholinesterase levels of skeletal muscle in several species of fish have been found. These results have been correlated with the observed physical activity of these fishes, and their deviation from an efficient hydrofoil.

Mexican blind cavefish have higher muscle, and lower brain ACHE activity levels than the closely related Mexican tetra. These observations have been correlated with an increased physical activity and lack of vision in the cave fish.

Tubificid worms have been found to have a very high level of ACHE activity. (Auth. summ.)

**4281.** Allison, Leonard N. 1961. THE FATE OF KIDNEY DISEASE AMONG HATCHERY BROOK TROUT STOCKED IN NATURAL WATERS. Progressive Fish-Culturist, Vol. 23, No. 2, pp. 76-78.

Kidney disease has caused mortalities of salmonid fishes at hatcheries from widely scattered locations in the United States. Numerous studies of the disease in hatcheries have been reported, but none have been concerned with the fate of the fish when stocked in natural waters. Brook trout from infected groups at Oden and Marquette hatcheries were stocked in 25 lakes and 2 streams. Lakes chosen for study had neither inlet nor outlet, and fish stocked there each year were identified by clipping various fins. Also, the lakes were either within research areas where permit fishing was in force or in areas where creel-census clerks checked fish regularly. Of the 164 trout collected from these waters, there were no instances in which kidney disease was transmitted from stocked fish to fish already present. No mortalities of trout were reported from any location where infected groups of fish were stocked, although these

locations were regularly visited by Department of Conservation personnel. It appears unlikely, therefore, that a mortality of brook trout would result from the stocking of fish infected with kidney disease. (Auth. abst.)

**4282.** Ali, M. A., W. R. Stevenson, and Judith S. Press. 1961. HISTOPHYSIOLOGICAL STUDIES ON THE JUVENILE ATLANTIC SALMON SALMO SALAR RETINA. I. RATES OF LIGHT - AND DARK - ADAPTATION. Canadian Journal of Zoology, Vol. 39, No. 2, pp. 123-128.

The structure of the Atlantic salmon retina corresponds to descriptions by previous workers and is also similar to that of the Pacific salmon retina. Retinal epithelial pigment light-adapts in 60 minutes. Cones light-adapt in 45 minutes. Dark-adaptation of the pigment and cones occurs in 70 minutes. Retinal index shows light-adaptation occurring in 60 minutes and dark-adaptation in 70 minutes. Results are compared with those of the Pacific salmon's. (Auth. abst.)

**4283.** Lambou, Victor W. 1959. USE OF MACHINE METHODS IN PROCESSING FISHERY DATA. Proceedings of the Thirteenth Annual Conference, Southeastern Association of Game and Fish Commissioners, pp. 116-120.

Most fishery management agencies are faced with the problem of an ever-increasing workload and a demand for more accurate and reliable information (Leeper, Stern, and Lambou, 1958). Research programs are being expanded and their standards are rapidly rising, necessitating more detail and complex analyses of data. Because of this, there is a need for: (1) machine manipulation of data and (2) improvement in the design and analyses of experiments. These are two distinct problems; however, they are related. This report will be primarily concerned with the need for machine manipulation of data. (Auth. intro.)

**4284.** Thomaston, W. W., Phillip C. Pierce, and Herbert N. Wyatt. 1959. EXPERIMENTAL USE OF SILVEX AND OTHER AQUATIC HERBICIDES IN GEORGIA FARM PONDS. Proceedings of the Thirteenth Annual Conference, Southeastern Association of Game and Fish Commissioners, pp. 101-107.

The results of two years experimental weed control in Georgia Farm Ponds using silvex, propylene glycol butyl ether ester, dalapon, sodium salt of 2, 2-dichloropropionic acid; 2, 4-D granules of iso-octyl ester of 2, 4-dichlorophenoxy acetic acid. Residual control and overall effectiveness is evaluated over a two-year period of aquatic weeds in approximately 100 ponds. Preliminary screen- of Inverton, an invert emulsion of 2, 4, 5-trichlorophenoxy acetic acid; Garlon, a solution of dalapon and silvex; and simazine, 2-chloro-4, 6 bis-(ethylamino) -S-trizaine are presented.

Different concentrations were used and observations made during 1958 and 1959. Results are presented for different herbicides and evaluation made for their effectiveness on specific aquatic weeds.

Silvex appears to have the widest range of control for underwater and emergent aquatic weeds. Preliminary results indicate this chemical is as effective as sodium arsenite in many situations. Dalapon has given some degree of control for grasses and satisfactory control for cattails. Granular 2, 4-D has given satisfactory control for water lilies and parrots feather (Myriophyllum brasiliense). Garlon and Inverton look promising for the control of some aquatic weeds. Simazine has not been generally effective for control or eradication of higher aquatic plants in the concentrations listed. (Auth. abst.)

**4285.** Surber, Eugene W. 1959. SUGGESTED STANDARD METHODS OF REPORTING FISH POPULATION DATA FOR RESERVOIRS. PREPARED FOR THE RESERVOIR COMMITTEE, SOUTHERN DIVISION OF THE AMERICAN FISHERIES SOCIETY. Proceedings of the Thirteenth Annual Conference. Southeastern Association of Game and Fish Commissioners, pp. 313-325.

During a meeting of the Southern Division's Reservoir Committee on June 1, 1959, the writer was directed by the Committee to review methods of reporting fish population data for reservoirs and to recommend a standard method.

In carrying out this project, it was necessary to keep in mind certain of the objectives in presenting population data. Reservoir workers, Wiebe (1942), Smith and Miller (1943), Tarzwell (1942), have observed that rough fish have increased in numbers following the early years of good sport fishing. The importance of determining the ratios of game fishes to rough fishes in large impoundments has been emphasized by Eschmeyer, Stroud, and Jones (1944), Tarzwell (1945) and more recently by Hall (1951).

Carter (1958) listed a number of reasons for collecting fish population data by rotenone sampling. Among them were the determination of species composition, standing crop, abundance of adult fish, success of natural reproduction, and information on year classes.

Southern biologists have been uniform in methods of collecting and recording the basic data. Field data sheets have invariably recorded each species of fish present in a population sample in one inch size classes. The weights of fish in each size class are generally recorded, therefore the two prime basic units for calculation of population dynamics are generally available. As stated by Chance (1958), "Interpretations and manipulations beyond this point depend on the need, use and inclination of the investigator."

Jenkins (1958) observed the need for extension and refinement of our ability to estimate the size and composition of fish populations as well as methods of field estimation, statistical treatment and presentation. He considered standard forms for recording the original field data a prime requisite. (Auth. abst.)

**4286.** Herke, William H. 1959. COMPARISON OF

THE LENGTH-WEIGHT RELATIONSHIP OF SEVERAL SPECIES OF FISH FROM TWO DIFFERENT, BUT CONNECTED HABITATS. Proceedings of the Thirteenth Annual Conference, Southeastern Association of Game and Fish Commissioners, pp. 299-313.

Length and weight data were gathered during a short time-period on several species of fish from a large lake and a connecting marsh canal. The marsh had recently gone dry, forcing the fish to crowd into the canal.

Analysis of covariance was used to compare the length-weight relationship of largemouth black bass Micropterus salmoides, redear sunfish Lepomis microlophus, and bluegill Lepomis macrochirus from both habitat types. The bass from the canal were found to be significantly heavier for their length than those from the lake. Various possible explanations for this phenomenon are discussed. The author's conclusion is that the most logical explanation for the phenomenon is increased feeding by the bass under these crowded conditions. No detectable difference was found in the length-weight relationship of redear sunfish and bluegill from the two habitats.

No chain pickerel Esox niger were captured in the lake but several hundred were taken in the canal. The length-weight relationship is also given for this species. (Auth. abst.)

**4287.** Alexander, Harold E. 1959. STREAM VALUES, RECREATIONAL USE AND PRESERVATION IN THE SOUTHEAST. Proceedings of the Thirteenth Annual Conference, Southeastern Association of Game and Fish Commissioners, pp. 338-343.

There is a recognition, everywhere, that certain streams have high quality recreational and esthetic values in their natural state which merit preservation; and that many of these values will be destroyed by what we call "water management."

There is an acute awareness that impoundments, channelization and other planned developments will eventually alter most of our streams, and will destroy certain values which we esteem.

There is an awareness that a positive program to preserve high quality streams is needed, and a recognition that stream values will increase in ratio to their scarcity as more and more of them are dammed, channelized, drained or otherwise "altered," destroying their original character.

So far, only sporadic, piece-meal attempts have been made to save stream values.

Since most stream values consist of what we term esthetic values, perhaps what we need most is a revision of that social concept which places material values above everything else.

In our resource conservation concepts we need, most of all, a recognition of the worth of moral and esthetic values, and assignment to these values a precedence equivalent to those we apply to the material needs of our society. Without the application of these great human principles, to water management, the streams we value for their particular recreational and esthetic qualities will be lost to us and future generations--forever. (Auth. abst.)

**4288.** Prather, E. E. 1959. THE USE OF CHANNEL CATFISH AS SPORT FISH. Proceedings of the Thirteenth Annual Conference, Southeastern Association of Game and Fish Commissioners, pp. 331-335.

The channel catfish Ictalurus punctatus has proved to be a very promising sport fish in ponds. Fingerlings stocked in February 1958 in a 12.4-acre pond at the rate of 2,000 per acre in combination with fathead minnows and largemouth bass, and given supplemental feeding daily except Sunday, average 0.7 pounds by September. During the following periods, September 24 to December 8, and March 14 to October 6, fishermen caught per acre 1,292.5 pounds of channel catfish, 36.9 pounds of largemouth bass, and 27.0 pounds of miscellaneous sunfish. The number of fishing trips per acre averaged 579 with a catch of 2.3 pounds per trip. Fishermen harvested 62 percent of the catfish stocked.

The pond was drained November 17, 1959, and 180 channel catfish weighing 391.2 pounds, 51 largemouth bass weighing 34.5 pounds, 907 fatheads weighing 2.4 pounds, and 80.2 pounds of "wild" fish were recovered per acre.

The mortality of the channel catfish was 29 percent, which is about 20 percent higher than in ponds that are not fished.

The channel catfish reproduced very little and less than one young catfish per acre was present when the pond was drained.

At $1 per fishing permit, fishermen paid 35 cents to $2.41 per pound for the catfish they caught; the average price paid was 46 cents per pound. The costs of production for fertilizer, feed, and fingerlings was 37 cents per pound.

The income per acre from fishing was $593.37, and the income from 391.2 pounds of catfish recovered when the pond was drained was $140.83 (234.7 pounds dressed weight at 60 cents per pound). This provided a total income of $734.20. The total cost per acre for fertilizer, feed, and fingerlings was $481.46. This leaves a return of $252.74 per acre for labor and capital. (Auth. abst.)

**4289.** Tebo, L. B., Jr. 1959. COMPARISON OF FISH POPULATIONS IN POLLUTED AND NON-POLLUTED ARMS OF A WARM-WATER RESERVOIR. Proceedings of the Thirteenth Annual Conference, Southeastern Association of Game and Fish Commissioners, pp. 220-228.

In the present study it was definitely demonstrated that a severe drawdown of an impounded reservoir for a period of five months during the fall and winter months was followed by unusually successful reproduction and survival of largemouth bass.

**4290.** Brady, Lee, and Andrew Hulsey. 1959. PROPAGATION OF BUFFALO FISHES. Proceedings of the Thirteenth Annual Conference, Southeastern Association of Game and Fish Commissioners, pp. 80-90.

Intense interest in commercial fish farming in Arkansas, due to crop acreage controls and other factors, stimulated experiments in buffalo fish propagation at the Joe Hogan State Fish Hatchery, Lonoke, Arkansas.

A pond method of propagation was developed necessitating the use of over-wintering or brood ponds, spawning ponds, nursery ponds and growing ponds.

The culture procedures are set forth in a step by step "cook book" fashion. (Auth. abst.)

**4291.** Mansueti, Romeo. 1959. COMMENTS ON THE NEED FOR CRITICAL FISHERY RESEARCH PLANNING AND ELECTRONIC DATA PROCESSING. Proceedings of the Thirteenth Annual Conference, Southeastern Association of Game and Fish Commissioners, pp. 107-113.

Two great problems facing fishery scientists who must improve and rapidly complete research projects involving large amounts of data are: (a) Improvement in the statistical design of projects; and (b) electronic data processing (EDP) with the aid of punch cards, paper and magnetic tape. Good statistical design of a project is usually achieved by a well-trained fishery scientist working in conjunction with a biostatistician. With EDP, the fishery scientist consults with a specially trained biostatistician associated with EDP procedure.

**4292.** Hester, F. Eugene. 1959. THE TOLERANCE OF EIGHT SPECIES OF WARM-WATER FISHES TO CERTAIN ROTENONE FORMULATIONS. Proceedings of the Thirteenth Annual Conference, Southeastern Association of Game and Fish Commissioners, pp. 121-133.

Laboratory tests were conducted in aquaria to determine the effectiveness of Sulfoxide as a synergist to rotenone for use as a fish poison. In order to compare the synergized product with standard formulations, Pro-Noxfish (2.5 percent rotenone, 2.5 percent Sulfoxide, 5 percent other cube extractives, and an emulsifier) was compared to Noxfish (5.0 percent rotenone, 10 percent other cube extractives, and an emulsifier), and to powdered cube (7.3 percent rotenone).

The relative toxicities of the three formulations were found to vary with water temperature, species of fish, and size of fish tested. (From auth. abst.)

**4293.** Hester, F. Eugene. 1959. THE TOXICITY OF NOXFISH AND PRO-NOXFISH TO EGGS OF COMMON CARP AND FATHEAD MINNOWS. Proceedings of the Thirteenth Annual Conference, Southeastern Association of Game and Fish Commissioners, pp. 325-331.

Laboratory experiments were conducted to determine the toxicity of Noxfish (an emulsifiable formulation containing 5 percent rotenone) and Pro-Noxfish (an emulsifiable formulation containing 2.5 percent rotenone plus 2.5 percent Sulfoxide as a synergist) to eggs of common carp (Cyprinus carpio) and fathead minnows (Pimephales promelas). Spawning devices were added to brood ponds and examined daily to obtain eggs of known age for testing. The carp eggs were 24 to 48 hours old when treated. Ninety percent of the carp eggs in control containers hatched. The $LD_{50}$'s obtained for carp eggs at approximately 75° F. were: Noxfish, 0.091 p.p.m., Pro-Noxfish, 0.178 p.p.m. Fathead minnow eggs less than 31 hours old or 101 to 120 hours old were equally susceptible to the poisons. Ninety percent of the fathead minnow eggs in control containers hatched. The $LD_{50}$'s obtained for fathead minnow eggs at 70° to 76° F were: Noxfish, 0.142 p.p.m.; Pro-Noxfish, 0.233 p.p.m. (Auth. abst.)

**4294.** Dees, Lola T. 1961. A LIST OF THE FISHERY BULLETINS OF THE UNITED STATES FISH AND WILDLIFE SERVICE. Fishery Leaflet 509, U. S. Fish and Wildlife Service, 14 pgs.

A list of 161 papers.

**4295.** Dees, Lola T. 1961. UNITED STATES FISH AND WILDLIFE SERVICE PUBLICATIONS IN LIMNOLOGY, 1940-1960. Fishery Leaflet 512, U. S. Fish and Wildlife Service. 7 pgs.

A list of 49 papers.

**4296.** Dees, Lola T. 1961. LIST OF SPECIAL SCIENTIFIC REPORT (Nos. 1-67) AND SPECIAL SCIENTIFIC--FISHERIES (Nos. 1-357). Fishery Leaflet 514, U. S. Fish and Wildlife Service, 36 pgs.

A list of 424 papers.

**4297.** Dees, Lola T. 1961. UNITED STATES FISH AND WILDLIFE SERVICE PAPERS ON PHYSICAL AND CHEMICAL OCEANOGRAPHY. Fishery Leaflet 515, U. S. Fish and Wildlife Service, 14 pgs.

A list of 116 papers.

**4298.** Dees, Lola T. 1961. A LIST OF CIRCULARS OF THE UNITED STATES FISH AND WILDLIFE SERVICE. Fishery Leaflet 518, U. S. Fish and Wildlife Service, 8 pgs.

A list of 87 circulars.

**4299.** Caldwell, David K. 1961. POPULATIONS OF THE BUTTERFISH, PORONOTUS TRIACANTHUS (PECK) WITH SYSTEMATIC COMMENTS. Bulletin of the Southern California Academy of Sciences, Vol. 60, Part 1, pp. 19-31.

Examination of large series of butterfish from throughout their range revealed three major populations: a deep-bodied form in the Gulf of Mexico; an intermediate form in Western Atlantic waters of 12 fathoms or less south of Cape Hatteras; and a generally shallow-bodied form in Western Atlantic waters north of Hatteras and south of Hatteras beyond 13 fathoms. Peprilus burti Fowler is placed in the synonymy of Poronotus triacanthus (Peck). (Auth. abst.)

**4300.** French, R. R., and R. J. Wahle. 1960. SALMON RUNS - UPPER COLUMBIA RIVER, 1956-57. Special Scientific Report Fisheries No. 364, U. S. Fish and Wildlife Service, 15 pgs.

Important runs of salmon pass Rocky Reach Dam

site on the Columbia River. The escapement of chinook salmon past Rocky Reach in 1957 was estimated to be approximately 11,000 spring chinook which spawn in the small remote tributaries and 6,000 summer chinook which spawn in the large tributaries of the Columbia River.

Blueback salmon passing Rocky Reach Dam site in 1956 and 1957 accounted for approximately 72 and 60 percent of the escapement passing Rock Island Dam, or about 67,000 fish in 1956 and 43,000 fish in 1957. They spawn in the Okanogan River in Canada. The rate of travel of blueback salmon was 13.5 miles per day. (Auth. abst.)

**4301.** Moore, Joseph E., and Donn S. Gorsline. 1960. PHYSICAL AND CHEMICAL DATA FOR BOTTOM SEDIMENTS, SOUTH ATLANTIC COAST OF THE UNITED STATES M/V THEODORE N. GILL CRUISES 1-9. Special Scientific Report--Fisheries No. 366, U. S. Fish and Wildlife Service, 84 pgs.

Detailed data are presented on the mechanical and chemical composition of bottom sediments collected during nine cruises of the M/V Theodore N. Gill off the south Atlantic coast of the United States. Methods and procedures are given for the various analyses. The pattern of the sediment textural types is discussed and presented graphically. (Auth. abst.)

**4302.** International Passamaquoddy Fisheries Board. 1960. PASSAMAQUODDY FISHERIES INVESTIGATIONS, 1957-1958, REPORT TO THE INTERNATIONAL JOINT COMMISSION. Special Scientific Report--Fisheries No. 360, U. S. Fish and Wildlife Service, 40 pgs.

A research committee composed of Canadian and United States scientists carried out oceanographic, biologic, and economic investigations in the Passamaquoddy area of southern New Brunswick and eastern Maine. Most of the work was done in the Quoddy Region which includes all of the area inside the line from Point Lepreau, N. C., to Northern Head, Grand Manan, N. B., thence to West Quoddy Head, Maine. The results of the investigations provide a basis for predicting the effects of the project on the fisheries. (From auth. summ.)

**4303.** Trites, R. W. 1961. PROBABLE EFFECTS OF PROPOSED PASSAMAQUODDY POWER PROJECT ON OCEANOGRAPHIC CONDITIONS. Journal of the Fisheries Research Board of Canada, Vol. 18, No. 2, pp. 163-201.

The proposed Passamaquoddy power project involves the construction of a series of dams across the mouth of Passamaquoddy and Cobscook Bays. Passamaquoddy Bay, the proposed high pool, will be filled near high water by 90 filling gates, and Cobscook Bay, the proposed low pool, will be emptied near low water by 70 emptying gates. Water will flow continuously from the high pool to the low pool, through a 30-turbine powerhouse. Tidal range will be reduced to approximately 4 and 8 ft. in the high and low pools respectively. The effect of this proposed installation on oceanographic conditions in the region has been considered. It is concluded that currents, within the impounded bays and in the area lying inside the Bliss Island-Head Harbour region, will be altered markedly. In the outer Quoddy Region, tidal stream directions will be altered only slightly, while the changes in speed will probably not exceed 20% of their present value. No significant change in residual flow is expected outside the Quoddy Region. Not more than a 1% increase in tidal range is anticipated for the entire Bay of Fundy. Inside the impounded bays, there will be increased stratification. Seasonal variations in temperature of the surface layer will be increased. The summer maximum is expected to reach 20°C and the winter minimum will be less than 0°C. Ice cover is expected to occur over part of the impounded waters. Salinities at the surface will be reduced. Only changes in temperature and salinity of the deep layer are anticipated. No significant changes are expected in temperature or salinity in the outer Quoddy Region. (Auth. abst.)

**4304.** Johannes, R. E., and P. A. Larkin. 1961. COMPETITION FOR FOOD BETWEEN REDSIDE SHINERS (RICHARDSONIUS BALTEATUS) AND RAINBOW TROUT (SALMO GAIRDNERI) IN TWO BRITISH COLUMBIA LAKES. Journal of the Fisheries Research Board of Canada, Vol. 18, No. 2, pp. 203-220.

The distribution, movements, behaviour and food of trout and shiners in Paul and Pinantan Lakes were studied to determine the items and mechanisms of interspecific competition between them. Data from recent years were compared with data for years when trout alone inhabited the lakes.

No interspecific aggression was observed. The possibility that the two species were competing for space was discounted. Stomach contents of shiners in Pinantan Lake revealed a marked qualitative diurnal food cycle. In Paul Lake, shiners have drastically reduced the Gammarus population relative to its pre-shiner abundance, forcing trout, as well as the shiners themselves, to shift their diets to other foods. This overgrazing was caused by the concentration of large numbers of shiners over the shoals where Gammarus are also present in their highest concentrations, and the ability of shiners to pursue food deeper into the weeds and to graze an area more thoroughly than trout. In Pinantan Lake, shiners have apparently reduced the density of Daphnia to a point where trout are unable to feed on them as rapidly as in pre-shiner years. The ability of both species to utilize many types of food tends to reduce the intensity of competition.

The study demonstrates how false implications may arise from an appraisal of competition not initiated until after the effects of competition have been observed. If observations had not been made on Paul Lake until after competition had been observed, the importance of Gammarus as an item of competition would probably have been overlooked and the whole competitive relationship misconstrued.

Environmental factors and behaviour were shown

to be important influences on the dynamics of competition The physical and biological environment and the distribution and behaviour of competitors may be in states of continual flux in which case the niches of the competitors cannot be considered constant. (Auth. abst.)

4305. McKenzie, R. A., and S. N. Tibbo. 1961. HERRING MOVEMENTS IN THE BAY OF FUNDY AND GULF OF MAINE, 1957 AND 1958. Journal of the Fisheries Research Board of Canada, Vol. 18, No. 2, pp. 221-252.

During 1957 and 1958, 137,469 herring were tagged in the southern part of the Bay of Fundy and the western part of the Gulf of Maine. These fish were immature and ranged in mean total length from 9.9 to 20.0 cm and in age from 1 to 3 years. Recovery of 3,582 (2.6%) tagged individuals showed that herring moved in and out of Passamaquoddy Bay irregularly throughout the summer and autumn with some tendency to concentrate at the head of this bay. Outward movement reached a peak in July when there was a considerable movement eastward towards Point Lepreau. Herring moved into Passamaquoddy from as far south as Grand Manan and from as far east as Point Lepreau. Little interchange of herring took place between the Passamaquoddy area and the coasts of Maine and Nova Scotia. The greatest straight-line distance from release to recovery points was 55 miles. More than half of the recaptures were made within 2 miles of the tagging sites and nearly two-thirds within 5 miles About 28% of the recaptures were made within 1 week after tagging and 63% within 2 weeks The average time before recapture was 12 days in 1957 and 17 days in 1958. The longest time between release and recapture for both years was 165 days Drift bottles released with tagged herring showed no apparent relationship between herring movements and surface drift. The results of tagging support a general conclusion that the proposed Passamaquoddy tidal power structures will have no significant effect on the herring fisheries of the Passamaquoddy area. (Auth. abst.)

4306. Zhadin, V. I. 1961. THE INTERNATIONAL LIMNOLOGICAL CONGRESS, 19 Aug. 1959. XIV MEZHDUNARODNYI LIMNOLOGICHESKII KONGRESS, 19 AVG. 1959. G. Zool. Zhur. 39(4):634-640. 1960; Referat. Zhur., Biol., 1960, No. 103211. Biological Abstracts, Vol. 36, No 9, Abst. No. 25922.

The Congress, in Austria, was attended by more than 500 delegates from 34 countries, among them 13 from the USSR. Sessions were held in Vienna and in Salzburg. More than 200 papers dealt with methods of studying primary production and requirements of animals, microbiological processes in bodies of water, the ecology of algae and animals, the fishes of natural bodies of water and cultivated in ponds, benthic deposits of lakes and other subjects. Sections were held on the following topics: metabolism and transformation of substances and energy in freshwater; investigations of running water; industrial fishing investigations and hydroelectric construction; and miscellaneous reports. Two sessions for the study of the Danube were also held during the Congress.

4307. Anderson, D. V. 1961. A NOTE ON THE MORPHOLOGY OF THE BASINS OF THE GREAT LAKES. Journal of the Fisheries Research Board of Canada, Vol. 18, No. 2, pp. 273-277.

Neumann (1959) has suggested the elliptic sinusoid as a model for an average lake. Area-depth curves for the Great Lakes are compared with the corresponding curves given by the Neumann model which, it is suggested, should be useful in idealized calculations on a lake. (Auth. abst.)

4308. Hitz, C. R. 1961. OCCURRENCE OF TWO SPECIES OF JUVENILE ROCKFISH IN QUEEN CHARLOTTE SOUND. Journal of the Fisheries Research Board of Canada, Vol 18, No 2, pp. 279-281.

The 8 rockfish found among the barnacles could be divided into two groups by their general appearance. Four of the rockfish had distinct black bands over a yellowish-gold background. The others were of a brownish-red colour with no distinct markings. Specimens having black stripes were identified as Sebastodes nigrocinctus and those having a brownish-red colour appeared to be Sebastodes caurinus

4309. Ketchen, K S., and R.M. Wilson 1961 A NEW RECORD OF THE LONG-FINNED COD, ANTIMORA ROSTRATA GUNTHER, FROM BRITISH COLUMBIA WATERS. Journal of the Fisheries Research Board of Canada, Vol. 18, No. 2, pg 291.

On August 17, 1960, a rare specimen of the long-finned cod (Antimora rostrata Gunther) was caught by Mr. M. Hestnes, skipper of the long-liner Sentinella, while fishing in waters off the west coast of Vancouver Island The place of capture was approximately 15 miles southwest of Kyuquot Sound (49°49' N, 127°41'W) and the depth was 250 fathoms.

4310. G. H. Lawler. 1961. EGG COUNTS OF LAKE ERIE WHITEFISH. Journal of the Fisheries Research Board of Canada, Vol. 18, No. 2, pp. 293-294.

The average number of eggs in whitefish of the 1944 year-class was 47,000, while the 8-year old whitefish had over 100,000 eggs.

With few irregularities, it is apparent that a general relationship exists between size of fish and egg number, i..e., small fish produce fewer eggs than large fish.

4311. Favorite, Felix. 1961. SURFACE TEMPERATURE AND SALINITY OFF THE WASHINGTON AND BRITISH COLUMBIA COASTS, AUGUST, 1958 AND 1959. Journal of the Fisheries Research Board of Canada, Vol. 18, No. 3, pp. 311-319.

Oceanographic data collected off the Washington and British Columbia coasts during August, 1958 and 1959, through Canadian and United States research programs provide the best synoptic coverage attained in this area. Comparison of August surface

data for the two years shows that the effects of local runoff can be traced over several hundred miles offshore. This implies, but does not necessarily confirm, the absence of any appreciable net surface current parallel to the coast northward of the Strait of Juan de Fuca to Dixon Entrance, in summer.

The 1958 observations were made at the time of the anomalous Fraser River sockeye run through Johnstone Strait and provide a good picture of the existing coastal and offshore oceanographic conditions. It is suggested that the seaward extent of dilute surface water may determine the location where homeward migrating salmon enter coastal waters. (Auth. abst.)

**4312.** Bevan, Donald E. 1961. VARIABILITY IN AERIAL COUNTS OF SPAWNING SALMON. Journal of the Fisheries Research Board of Canada, Vol. 18, No. 3, pp. 337-348.

A study of spawning ground surveys for pink salmon (Oncorhynchus gorbuscha) was made in two streams on Kodiak Island. An experimental design is described which permits replication of observers' counts of spawning salmon. The variance in an observer's estimate was found to be proportionate to the size of the estimate. The experiments indicated that an observer will detect differences in population size of plus or minus 50%. The relationship between counts of one observer and another changes within different streams, but within each river the observations of one observer were correlated with those of another. The results of the experiments are summarized in recommendations for aerial surveys of spawning salmon. (Auth. abst.)

**4313.** Scott, D. P. 1961. RADIOACTIVE IRON AS A FISH MARK. Journal of the Fisheries Research Board of Canada, Vol. 18, No. 3, pp. 383-391.

Experiments designed to test the feasibility of using radioactive iron as a fish mark are described. The biological half-life (turnover) or iron in speckled trout, Salvelinus fontinalis, was found to be probably at least 2 years. Iron-59, with a physical half-life of 45.1 days, was used in the experiments. (Auth. abst.)

**4314.** Vanstone, W. E., and F. Chung-Wai Ho. 1961. PLASMA PROTEINS OF COHO SALMON, ONCORHYNCHUS KISUTCH, AS SEPARATED BY ZONE ELECTROPHORESIS. Journal of the Fisheries Research Board of Canada, Vol. 18, No. 3, pp. 393-399.

Plasma proteins, as separated by zone electrophoresis, of coho salmon have been investigated from an early age to spawning and death. A protein fraction which may be similar to -globulin in other vertebrates increased throughout the period studied. Smolt transformation was associated with a temporary disappearance of the fastest migrating protein fraction. A lipoprotein fraction, presumably serum vitellin, was associated with egg formation. Serum vitellin was absent from the plasma of males, immature females, spawning females and spawned-out females. (Auth. abst.)

**4315.** Houston, Arthur H. 1961. INFLUENCE OF SIZE UPON THE ADAPTATION OF STEELHEAD TROUT, SALMO GAIRDNERI, AND CHUM SALMON, ONCORHYNCHUS KETA TO SEA WATER. Journal of the Fisheries Research Board of Canada, Vol. 18, No. 3, pp. 401-415.

Steelhead trout in the smolt phase of development adapted to sea water (salinity 22-24 parts per thousand) more rapidly and with less extensive departures from regulated conditions of water-electrolyte balance than did the larger post-smolts. By contrast, the extent and duration of the corresponding changes accompanying adaptation of juvenile chum salmon to sea water varied inversely with size. The data are discussed in relation to the distinction between smolting and non-smolting salmonid species. (Auth. abst.)

**4316.** Keleher, J. J. 1961. COMPARISON OF LARGEST GREAT SLAVE LAKE FISH WITH NORTH AMERICAN RECORDS. Journal of the Fisheries Research Board of Canada, Vol. 18, No. 3, pp. 417-421.

The largest sizes for 11 of 25 species of Great Slave Lake fish are presented from material collected during studies dating from 1944 and other sources. The North American size records compiled from a literature search also are given. Only two of the Great Slave Lake records exceed the existing North American ones. It is suggested that the maximum size of fish is not attained among unexploited populations in oligotrophic lakes. (Auth. abst.)

**4317.** Rawson, D. S. 1961. THE LAKE TROUT OF LAC LA RONGE, SASKATCHEWAN. Journal of the Fisheries Research Board of Canada, Vol. 18, No. 3, pp. 423-462.

The lake trout, Salvelinus namaycush, of Lac la Ronge was studied in the years 1958 to 1959 using gill netting, tagging, creel census and sampling of the spawning run. The trout spawned on shallow rocky reefs in the first week of October, when water temperatures were about 10°C (50°F). Of the spawning run, 82% were from 7 to 12 years old. Possibly 10% of the mature trout failed to spawn in any single year.

Growth rate varied widely in individuals and the average rate produced, at 10 years, a trout of 26 inches (66 cm) fork length and weighing 8 lb (3.6 kg.). No difference was found between growth rates of males and females and there was no change in average growth rate during the 10 year study. However, trout in the main lake grew considerably faster during their first 5 years than those in the deeper, colder Hunter Bay. Thirty-three trout weighing from 30 to 43 lb were examined.

Ciscoes, whitefish, ninespine sticklebacks and other fish made up 90% of the food of adult trout. The crustaceans Mysis and Pontoporeia were eaten in moderate quantities, especially by trout in their third and fourth years. Two cestode parasites were found in the intestine and the larvae of a third in the muscle

of trout.

The trout were widely scattered from break-up of ice in mid-May to late June. As the upper water warmed above 10°C (50°F) they moved down and were concentrated in areas deeper than 20 m (65 ft) during July and August. As the water cooled they again spread into shallow water about mid-September. Of 429 tagged, 60 or 14% were recovered during the first, second and third years after tagging. Recoveries showed extensive movement throughout the lake and a moderate exchange between the main lake and Hunter Bay.

In standard gill-net catches plankton-feeding and bottom-feeding fish outweighed piscivores by 3 to 1 in the main lake and 1.8 to 1 in Hunter Bay. Catch data suggest that the trout population was greater in 1958-59 than in 1948-49. The average size of trout caught and the year-class composition were unchanged after 10 years.

By diverting commercial fishing from trout to whitefish the average commercial catch in the 10-year period has been maintained at 250,000 lb per year, as compared to 316,000 lb in the previous 30 years. The anglers' catch of trout now averages 30,000 lb per year and this could be doubled without exceeding the known capacity of the lake for trout production. The creel census shows no decrease in average size of trout caught, average catch per angler, and number of very large trout taken. (Auth. abst.)

**4318.** Smith, M. W. 1961. A LIMNOLOGICAL RECONNAISSANCE OF A NOVA SCOTIAN BROWN-WATER LAKE. Journal of the Fisheries Research Board of Canada, Vol. 18, No. 3, pp. 463-478.

Summer hydrography and biota of a Nova Scotian brown-water lake are described. A bloom of a dinoflagellate was noted. Zooplankton was plentiful. With a range in pH of 4.3-4.8, mollusks were absent. Chaoborus dominated in the poor bottom fauna. Standing crop of fish was low at 19 kg per ha. Yellow perch were most numerous, exhibiting a decline in growth rate to age III, then increasing when the fish reached a size to be piscivorous. Fish-cultural implications are briefly discussed. (Auth. abst.)

**4319.** McGary, James W., and Joseph J. Graham. 1960. BIOLOGICAL AND OCEANOGRAPHIC OBSERVATIONS IN THE CENTRAL NORTH PACIFIC JULY-SEPTEMBER 1958. U. S. Fish and Wildlife Service, Special Scientific Report: Fisheries No. 358, 107 pgs.

This report contains the biological (including fishing) and oceanographic data collected in the central North Pacific during the July-September 1958 period from the U. S. Bureau of Commercial Fisheries research vessel Hugh M. Smith and the M/V Paragon. The latter made a commercial-scale gill-net survey for albacore under a contract with the Bureau. Scientists and crew aboard the former collected oceanographic, biological, and fishing data to permit a comparison of conditions in 1958 with those of previous years. The major effort of both vessels was in the area between 155° and 175° W. longitude and from 41° to 48° N. latitude. (Auth. abst.)

**4320.** Anonymous. 1961. MILFOIL INVADES CHESAPEAKE. Maryland Department of Research and Education, Chesapeake Biological Laboratory, Solomons, Maryland. 4 pgs.

Eurasian water milfoil (Myriophyllum spicatum) is detrimental to navigation, waterfowl, fishing, swimming and causes ecological changes with unknown effects on affected areas. A research program for Maryland is proposed. It includes studies of the effects of milfoil invasion, and the design and evaluation of control methods (chemical and mechanical).

**4321.** Dragovich, Alexander, John H. Finucane, and Billie Z. May. 1961. COUNTS OF RED TIDE ORGANISMS, GYMNODINIUM BREVE, AND ASSOCIATED OCEANOGRAPHIC DATA FROM FLORIDA WEST COAST, 1957-59. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 369. 175 pgs.

This report consists of oceanographic data and counts of the red tide organisms, Gymnodinium breve, for the period from July 1957 to January 1960. Methods of collecting and analyzing samples are described. Data on water temperature, water transparency, cloud amount, salinity, copper, inorganic phosphate, total phosphorus, and nitrate-nitrite nitrogen are presented. These data were collected as part of a study on the distribution and incidence of G. breve and related ecological conditions and extend the records reported in a previous paper from 1954 to 1960. (Auth. abst.)

**4322.** Piavis, George W. 1961. EMBRYOLOGICAL STAGES IN THE SEA LAMPREY AND EFFECTS OF TEMPERATURE ON DEVELOPMENT. U. S. Fish and Wildlife Service, Bureau of Commercial Fisheries, Fishery Bulletin 182, Vol. 61, pp. 111-143.

Early embryology of the sea lamprey has been subdivided into 19 stages. The stages are based largely on external morphology, behavior, and organ function. The holoblastic cleavage of sea lamprey eggs exhibited two types of third and fourth cleavages, equatorial and meridional. The open blastopore had an apparent migration over the surface of the embryo until it became the anus. Gastrulation resembles teleostean gastrulation in some characteristics and amphibian in others. Lamprey neurulation resembles teleostean neurulation more closely than it does amphibian.

Sea lamprey eggs were reared experimentally at 10 constant temperatures (at 5° intervals from 45° to 80° F., inclusive, and at 52.5° and 77.5° F.). No viable, burrowing larvae were produced at any temperature below 60° F. or above 70° F. Optimum temperature was 65° F. which yielded 78 percent survival to the burrowing stage; survival to the same stage was much lower at 60° F. (12 percent) and 70° F. (5 percent). The stage attained before all embryos were dead decreased as the temperatures were shifted in either direction from the 60°-70° F. interval. In

general, developmental rate became faster, lengths of stages became shorter, and overlap between stages was lessened as temperature increased.

The evidence that sea lamprey eggs can develop successfully only within a limited temperature range suggests that unfavorable temperatures may account for the failure of certain apparently suitable streams to produce larval lampreys. (Auth. abst.)

**4323.** Dragovich, Alexander. 1961. RELATIVE ABUNDANCE OF PLANKTON OFF NAPLES, FLORIDA, AND ASSOCIATED HYDROGRAPHIC DATA, 1956-57. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 372, 41 pgs.

Some chemical, physical, and plankton characteristics of the surface waters at Naples, Florida, have been investigated. Concentrations of inorganic phosphate, total phosphate, nitrate-nitrite nitrogen, carbohydrate, and protein were determined over a period of 17 months. Water temperatures, salinities, occurrence, and composition of phytoplankton and zooplankton were also recorded. (Auth. abst.)

**4324.** Thrailkill, James R. 1961. ZOOPLANKTON VOLUMES OFF THE PACIFIC COAST, 1958. U. S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 374, 70 pgs.

Basic data on volumes of zooplankton off the Pacific coast in 1958 are given, together with haul data for all plankton hauls taken on survey cruises of the California Cooperative Oceanic Fisheries Investigations. Plankton volumes over the entire survey area averaged less than one-third as much as during 1951-56. Distribution charts showing relative areal zooplankton abundance by month are included. (Auth. abst.)

**4325.** Ellis, Robert W., Albert Rosen, and Alan W. Moffett. 1958. A SURVEY OF THE NUMBER OF ANGLERS AND OF THEIR FISHING EFFORT AND EXPENDITURES IN THE COASTAL RECREATIONAL FISHERY OF FLORIDA. State of Florida Board of Conservation, Technical Series, No. 24, 50 pgs.

Summing up the various categories, a total of about 20 million fisherman-days were spent in all types of recreational salt and brackish water fishing in Florida during the study period.

Anglers' expenditures during 1955, directly in the pursuit of, or indirectly due to salt and brackish water fishing, are categorized. The total expenditures on items normally incurred daily were estimated at about $135 million for the year, tackle at $6 million, motors at $3 million, boat and boating accessories at $18 million, miscellaneous items at $15 million, and fishing trip travel at $20 million. These expenditures relating to fishing totalled almost $200 million. It was estimated that visiting anglers spent a further $61 million on items not directly related to fishing. A portion of this total might be attributed to the attraction of the fishery.

**4326.** Baxter, John L. 1960. A STUDY OF THE YELLOWTAIL, SERIOLA DORSALIS (GILL). California Department of Fish and Game, Marine Resources Operations, Fish Bulletin No. 110, 96 pgs.

Yellowtail have been recorded from southern Washington south to Cape San Lucas, Baja California, and north again throughout much of the Gulf of California.

Racial studies indicate there is but one randomly intermingling population of yellowtail, Seriola dorsalis, on the west coast of the United States and Mexico. A detailed redescription of the species was based on morphometric measurements and meristic counts taken from the 210 specimens, 357 to 970 mm. standard length, used in the racial study.

An extremely abundant yellowtail population exists along the central Baja California coast and it is the vagaries of the environment and not the fishing pressure that currently limits their availability to California anglers. Yellowtail have always been of secondary commercial value and at present there is virtually no commercial fishery for them.

Yellowtail were aged by means of scales through the seventh year, after which aging became increasingly difficult. The mean fork lengths in inches for age groups one through seven are: I - 19.9; II - 25.0; III - 27.8; IV - 30.8; V - 32.7; VI - 34.3; VII - 35.2. The rate of growth calculated from tag return data compared favorably with that determined by scale analysis.

Differences in the weight-length relationship between sexes were insignificant so the data were combined with the resulting formula $W = 0.00000007439 L^{2.85}$.

Yellowtail are predominantly daytime feeders. Their selection of food items indicate they are "opportunists," feeding on whatever is most abundant at the time and place they happen to be. Squid and pelagic red crabs were most often observed of the invertebrates. Sardines, anchovies, jack mackerel, and Pacific mackerel were the most important forage fishes.

Some fish will spawn in their second year and all are mature in their third. The spawning season extends from July through October and after their first spawning season yellowtail will spawn more than once within this period each year.

The number of eggs produced for one spawning was found to vary with the weight of the fish. It was estimated that a 10-pound fish spawns 450,000 eggs; a 15-pound fish 700,000; and a 20-pounder 940,000.

From 1951 to 1957 15,161 yellowtail were tagged throughout their known range and 532 subsequently were recovered. Tag returns indicated that most fish caught in our waters migrated there from central Baja California. Fish from the lower peninsula and the Gulf of California probably do not enter our fishery.

The present population appears to be in a healthy state and there is no need for further restrictions so long as it remains that way. The fishery should be checked periodically in order to determine whether or not any changes have occurred that could produce an adverse effect on the status of the population. (From auth. summ.)

**4327.** Purkett, Charles A., Jr. 1961. REPRODUCTION AND EARLY DEVELOPMENT OF THE PADDLEFISH. Transactions of the American Fisheries Society, Vol. 90, No. 2, pp. 125-129.

Paddlefish, Polyodon spathula (Walbaum), were observed spawning over gravel bars in the Osage River, Missouri. Eggs and prolarvae were collected. Eggs were hatched and young paddlefish were reared. The external features of the egg and prolarvae, hatching, and early behavior of the larvae are described. The effect of impoundment of rivers on the paddlefish population is discussed. (Auth. abst.)

**4328.** Carlander, Kenneth D., and Richard R. Whitney. 1961. AGE AND GROWTH OF WALLEYES IN CLEAR LAKE, IOWA, 1935-1957. Transactions of the American Fisheries Society, Vol. 90, No. 2, pp. 130-138.

Interpretation of walleye (Stizostedion vitreum vitreum) scales by three investigators revealed some differences in detail, but the data derived appeared to be basically reliable. Most fish were collected in experimental gill nets. Lengths at annuli were calculated using straight-line relationship with an intercept of 3.26 inches, total length. Growth rate of a year class, as indicated by mean length at the third annulus, was negatively correlated with abundance of the year class ($r = -0.78$, 11 d.f.). Walford's growth transformation did not give an entirely satisfactory fit but gave a maximum length of 31.1 inches and a k of 0.836. Variations in these values with different treatment of the data were indicated. Fitting a Walford transformation to increments gave: $L_{t+1} = 28.8$ inches $(0.172) + 0.828\ L_t$. The correlation coefficient, r, between the annual increment indexes and the mean May to September temperatures was 0.565. Adding April and October temperatures lowered the correlation. Instantaneous growth rates, i, decrease rapidly with age and with increased length. Several indexes to growth during calendar years using i values and Parker and Larkin's $L^2$ values, were tried, but the Hile increment indexes gave the best correlation with summer temperatures. Growth of female walleyes was faster than that of males. (Auth. abst.)

**4329.** Larsen, Howard N., and S. F. Snieszko. 1961. MODIFICATION OF THE MICROHEMATOCRIT TECHNIQUE WITH TROUT BLOOD. Transactions of the American Fisheries Society, Vol. 90, No. 2, pp. 139-142.

Commercial and laboratory-prepared capillary tubes for hematocrit were tested. A 10 percent solution of heparin was found to be best for the preparation of treated capillary tubes. For examination of trout blood laboratory-prepared capillary tubes were found to be superior to commercial tubes which are designed for human blood. Sharp, pointed heparinized capillary tubes were used with good results for collecting blood from the heart without killing the examined fish. Hematocrits determined directly in such tubes were found to have the same value as those prepared in other ways. (Auth. abst.)

**4330.** Weiss, Charles M. 1961. PHYSIOLOGICAL EFFECT OF ORGANIC PHOSPHORUS INSECTICIDES ON SEVERAL SPECIES OF FISH. Transactions of the American Fisheries Society, Vol. 90, No. 2, pp. 143-152.

Fish brain acetylcholinesterase is inhibited in vivo by organic phosphorus insecticides at concentrations of 0.1 mg/l and lower. The degree of inhibition is a function of the concentration of the insecticide, the extent of exposure, specific chemical nature of the inhibiting substance, and fish species. Species used were largemouth bass, Micropterus salmoides, bluegill, Lepomis macrochirus, golden shiner, Notemigonus crysoleucas, goldfish, Carassius auratus, and fathead minnow, Pimephales promelas. Fish removed from exposure to acetylcholinesterase-inhibiting insecticides, prior to reaching lethal limits, demonstrate the capacity for regeneration of this enzyme. The time required to regenerate the brain acetylcholinesterase to normal levels depends on the extent of the initial inhibition, the specific nature of the compound producing the inhibition, and the particular species. The curve of brain enzyme inactivation and recovery, as defined by percentage changes in normal activity, describes a physiological brain cholinesterase characteristic of the fish species. The period necessary to regenerate to normal activity may be longer than 30 days. By utilization of suitable fish species it is possible to demonstrate the presence of organic phosphorus insecticides in water at concentrations of 0.1 mg/l with exposure periods of 12 to 24 hours. Some compounds produce marked inhibition of brain enzyme activity in 6 hours. At 0.01 mg/l Guthion produces comparable in vivo inhibition of brain acetylcholinesterase in 12 hours' exposure in several species. (Auth. abst.)

**4331.** Beeton, Alfred M. 1961. ENVIRONMENTAL CHANGES IN LAKE ERIE. Transactions of the American Fisheries Society, Vol. 90, No. 2, pp. 153-159.

Comparison of data compiled during the past 60 years with those from recent studies shows that major changes have occurred in the bottom and fish faunas of Lake Erie. The bottom fauna was formerly dominated by the nymphs of Hexagenia, but at present midge larvae and oligochaetes are most abundant. blue pike, Stizostedion vitreum glaucum, and cisco, Coregonus artedii, which formerly dominated the commercial catch, are scarce, while other species are more plentiful than formerly. The concentrations of various major ions have increased as much as 10 p.p.m. The mean annual water temperatures are approximately 2°F. warmer today than during the 1918-28 period. Low levels of dissolved oxygen have been observed several times since 1930, and recently very low concentrations were found in the bottom waters covering many square miles of the central basin. Although similar conditions may have existed in the past, it appears that greater areas are involved at the present. (Auth. abst.)

**4332.** Donaldson, Lauren R., and Deb Menasveta. 1961. SELECTIVE BREEDING OF CHINOOK SALMON. Transactions of the American Fisheries Society, Vol. 90, No. 2, pp. 160-164.

Selective breeding of plants and animals has been carried on for hundreds of years. Few attempts, however, have been made to breed salmon that have characteristics which would better fit the fish for the needs of modern salmon management. Experiments started in 1949 at the University of Washington to develop a selected stock of chinook salmon, Oncorhynchus tshawytscha, have shown progress in producing fish better adapted to the environment available to them. Selected stocks grow faster, are more resistant to high temperatures and disease, mature earlier, and have a higher survival rate than the non-selected stocks. (Auth. abst.)

**4333.** Rupp, Robert S. 1961. MEASUREMENT OF POTENTIAL FISHING QUALITY. Transactions of the American Fisheries Society, Vol. 90, No. 2, pp. 165-169.

The commonly used "average catch per hour" does not provide a satisfactory measure of the quality of sport fisheries because of the extreme variation in the efficiency of the angler hour. A catch rate calculated from that portion of the data which comprises the more efficient effort units is a more precise statistic, and is probably more closely related to the actual condition of the fishery and to the effects of management. Three examples of creel census data are used to illustrate a suggested method for calculating this measure of potential fishing quality, and a standardized notation for presenting the results is recommended. (Auth. abst.)

**4334.** Van Oosten, John. 1961. RECORDS, AGES, AND GROWTH OF THE MOONEYE, HIODON TERGISUS, OF THE GREAT LAKES. Transactions of the American Fisheries Society, Vol. 90, No. 2, pp. 170-174.

Mooneyes (Hiodon tergisus) are very scarce in the upper three Great Lakes since only four specimens have been received from Lake Michigan, one from Lake Huron, and none from Lake Superior. The published statistics of the mooneyes are erroneous. Those of 1931 of Lake Michigan were perhaps chubs (Coregonus spp.) and those of Lake Huron of 1929 were also chubs and of 1934, 1949, and 1951 were gizzard shad (Dorosoma cepedianum) but since 1956 were alewives (Alosa pseudoharengus). Mooneyes are common in Lakes Erie and Ontario and perhaps in Lake St. Clair but are commercialized only in the States of Ohio and Michigan. Virtually all Lake Erie mooneyes were caught in trap nets, pound nets, and seines in less than 35 feet of water. Their life-history data collected in 1927-31 included lengths and weights of age-groups I-VII, calculated increments and lengths based on both anterior radii and lateral diameters of scales, length-weight relationships, and sexual maturity. Apparently mature specimens exceeded 8.8 inches, 3.25 ounces, and age-group I. (Auth. abst.)

**4335.** Baldwin, Ruth E., Dorothy H. Strong, and James H. Torrie. 1961. FLAVOR AND AROMA OF FISH TAKEN FROM FOUR FRESH-WATER SOURCES. Transactions of the American Fisheries Society, Vol. 90, No. 2, pp. 175-180.

Taste-panel studies were conducted on fish taken from four fresh-water sources which included a cold deep lake, a shallow mixed water lake, and flowages above and below the entry of effluent from industrial plants. Fish were sampled at four seasons of the year. Taste-panel members rated the fish as to acceptability and described any unusual flavor or aroma noted. Statistical treatment of the data demonstrated that walleye, Stizostedion vitreum vitreum, taken from the source below the entry of effluent from industrial plants generally scored significantly lower than those from other sources. This trend was not as pronounced for carp, Cyprinus carpio, or for northern pike, Esox lucius. A predominance of undesirable descriptive terms was evident for the fish representing the lower-scoring source. (Auth. abst.)

**4336.** Robson, D. S., and D. G. Chapman. 1961. CATCH CURVES AND MORTALITY RATES. Transactions of the American Fisheries Society, Vol. 90, No. 2, pp. 181-189.

The assumptions necessary to obtain a valid estimate of survival rate from a single catch curve are discussed. An example of the best estimate of survival rate and its variance is worked out for the case that age is known exactly for the entire sample. A test for validity of the model is illustrated. Methods of estimating the survival rate are also given when some age groups are combined, when an age-length key is used, and when only a segment of the catch curve is usable. A table is provided to facilitate the estimation in this last case. (Auth. abst.)

**4337.** Smith, Lloyd L., Jr., and Richard L. Pycha. 1961. FACTORS RELATED TO COMMERCIAL PRODUCTION OF THE WALLEYE IN RED LAKES, MINNESOTA. Transactions of the American Fisheries Society, Vol. 90, No. 2, pp. 190-217.

Growth of the walleye, Stizostedion vitreum vitreum, in Red Lakes, Minnesota, over a 17-year period was slower than in other waters of the Great Lakes region and fluctuated annually from 30.7 percent above to 42.2 percent below mean growth. Individual year classes varied considerably in growth rate. Age distribution in 3 1/2 inch stretch-measure commercial nets varied extremely in 9 years' collections and was related to year-class strength and fishing intensity during periods when classes were available for catch. Abundance of different classes varied 23-fold. Annulus formation and resumption of growth occurred from mid-June to late July. Effective growing season did not exceed 4 months and for some individuals in some years was 2 months or less. The catch contained age-groups II-XII but consisted principally of groups IV-VIII. Seasonal changes in age distribution were dependent on growth rate and fishing effort. Total catch was strongly influenced by growth and seasonal distribution of

fishing effort. Maximum availability to commercial nets was at a total length of 15.1 inches, but a large percentage of the catch was smaller fish. Total annual mortality rate after fish attained 15.1 inches total length was 0.66, but continued recruitment through group VIII caused apparent change in mortality rate with increasing age up to IX. Maximum harvest could be attained by concentrating fishing effort in the latter part of the growing season. Abundance indices derived from commercial catch will be strongly influenced by the seasonal pattern of fishing. (Auth. abst.)

**4338.** Benson, Norman G., John R. Greeley, Melvin I. Huish, and Jerome H. Kuehn. 1961. STATUS OF MANAGEMENT OF NATURAL LAKES. Transactions of the American Fisheries Society, Vol. 90, No. 2, pp. 218-224.

Lakes of various regions of continental United States and Canada are characterized. Northeastern and Rocky Mountain lakes are predominantly useful for trout and allied species, while those of other areas are managed for a wide variety of species. Major management problems are discussed and current management practices for different fish populations are outlined. Population and habitat control are major management tools. Fish planting has limited use but is effective when properly applied. Major research needs for management include study of fish toxicants, methods of population control, fish planting techniques, and methods of evaluating natural hatches. (Auth. abst.)

**4339.** Waters, Thomas F., and Robert J. Knapp. 1961. AN IMPROVED STREAM BOTTOM FAUNA SAMPLER. Transactions of the American Fisheries Society, Vol. 90, No. 2, pp. 225-226.

A sampler was designed for the Valley Creek investigations which incorporated the advantages of Hess's sampler and also overcame the two principal disadvantages. A circular frame of 13.56-inch diameter (1 square foot in area) was constructed of 1/4-inch diameter metal rod, and a strip of 2-inch-wide sheet metal was attached around the bottom of the frame. The frame was covered with Nitex[2] of mesh size of 471 microns, 39 meshes to the inch, which satisfactorily prevented drifting organisms from entering the sampler, with the collecting net of the same material extending downstream. The problem of removing the sample from the collecting net was facilitated by attaching, by a zipper, a small collecting bag which, with the sample, could be removed from the sampler, similar to the zipper bag employed on a drag-type sampler introduced by Usinger and Needham (1956). (Auth.)

**4340.** Blahm, T. H. 1961. EFFECT OF TRICAINE METHANESULFONATE ON OXYGEN CONSUMPTION OF JUVENILE SOCKEYE SALMON. Transactions of the American Fisheries Society, Vol. 90, No. 2, pp. 226-227.

The results not only showed the expected depression of the respiratory rates of the anesthetized fish, but also indicated a uniformity of the drug's effect. It is obvious that the oxygen consumption per unit weight of the small fish is higher than that of the large fish. This difference is apparent not only before but after anesthetization. An analysis of variance showed no significant difference at the 5 percent level in the amount of respiratory depression between large and small fish regardless of the rate prior to anesthetization. This indicates that within this species the drug acts uniformly on fish of different sizes. (Auth.)

**4341.** McCarraher, D. B. 1961. EXTENSION OF THE RANGE OF NORTHERN PIKE, ESOX LUCIUS. Transactions of the American Fisheries Society, Vol. 90, No. 2, pp. 227-228.

Recent technical publications and popular literature have not fully established the present geographical range of the northern pike. A survey by the writer in 1955 showed that 26 states and Canadian provinces had resident northern pike populations. During the past 5 years pike have been introduced into several other states, thus extending the range. Pike are already established in most of the northern states and are now being released into waters of the south and west. (Auth.)

**4342.** Walburg, Charles H. 1961. NATURAL MORTALITY OF AMERICAN SHAD. Transactions of the American Fisheries Society, Vol. 90, No. 2, pp. 228-230.

Since 1950 the Bureau of Commercial Fisheries has studied the American shad (Alosa sapidissima) of the Connecticut River to obtain information whereby the population may be managed to obtain optimum sustained yields. A necessary part of these investigations is the determination of the natural mortality of adult fish. If the average annual fishing mortality rate is known for the period under consideration, then the average annual natural mortality rate can be determined from Ricker's (1958) formula:

$$a = m + n - mn$$

where a is the annual total mortality rate, m is the annual fishing mortality rate, and n is the annual natural mortality rate. From unpublished data it was calculated that the average annual fishing mortality rate on shad fully vulnerable to capture (fish larger than 16.7 inches fork length) over the period 1956-59 was 36 percent (range 30-40 percent). The estimated average annual natural mortality rate during the period 1956-59 was therefore 58 percent.

The high natural mortality rate of adult shad is verified by the scarcity of older age groups in the catch and the preponderance of newly matured fish. This phenomenon has been found not only for the Connecticut River population but also for all Atlantic coast populations south to Chesapeake Bay. (Auth.)

**4343.** Carlander, Kenneth D. 1961. VARIATIONS ON REREADING WALLEYE SCALES. Transactions of the American Fisheries Society, Vol. 90, No. 2, pp. 230-231.

Despite the nonrepeatability of some of the scale readings, the data derived on the basis of the final

readings indicate that the readings are probably accurate. Ages of individual fish cannot be assessed with a great deal of certainty, but the errors will average out or will be submerged to the degree that bias does not interfere with general interpretations when samples are large. The degree of nonrepeatability of readings, of course, will differ with populations, species, and biologists. (Auth.)

**4344.** Hatch, Richard W., and Dwight A. Webster. 1961. TROUT PRODUCTION IN FOUR CENTRAL ADIRONDACK MOUNTAIN LAKES. Cornell University, Agricultural Experiment Station, New York State College of Agriculture, Ithaca, N. Y., Memoir 373, 81 pgs.

Four, subalpine, oligotrophic lakes near Old Forge, New York, were sampled twice a year from 1955 to 1957 in a study of productive capacity. Two lakes are shallow and unstratified while two regularly stratify. All are neutral, soft-water lakes with total alkalinities ranging from 2 to 10 p. p. m.

All lakes were reclaimed with rotenone and restocked with brook trout, Salvelinus fontinalis (one lake also received rainbow trout, Salmo gairdneri). Trout reared from unselected wild eggs and two domestic stocks were planted.

Growth rates varied considerably between lakes, year classes, and origin of stock. Wild fish ranged from 7. 4 to 10. 1 inches and 0. 17 to 0. 39 pounds in mean length and weight respectively at the end of second growing season. Domestic stocks varied from 9. 1 to 11. 5 inches and 0. 28 to 0. 62 pounds at the same age. Rainbow trout ranged from 11. 7 to 12. 5 inches and 0. 56 to 0. 69 pounds at this age. Growth in shallow, unstratified lakes was faster than growth in deeper lakes but, after age II+, growth slowed markedly in the former waters.

Standing crops ranged from 7 to 18 pounds per acre; values averaged about one-third higher in 1956 than 1957. This was primarily due to differences in stocks planted. Angling harvests ranged from 3. 5 to 5. 8 pounds per acre during two seasons of study. No difference in harvest between years or lakes was evident.

Annual total mortality rate of sexually mature wild stocks ranged from 0. 54 to 0. 89 with a mean of 0. 64. In domestic stocks, total mortality rates for the first year after stocking ranged from 0. 58 to 0. 85 with a mean of 0. 76. It was not possible to measure mortality of domestic stocks over an interval comparable with that used for wild stocks because the former group rapidly becomes extinct after age I+, and the latter group is incompletely vulnerable to sampling until age I+. The annual rate of exploitation for wild stock varied from 0. 15 to 0. 30 and, for domestic stock, from 0. 20 to 0. 43 during the first year at large.

Gross production ranged from 6 to 12 pounds per acre per year. Changes in stocks made 1956 values 50 percent higher than those for 1957. Differences between years were much greater than differences between ponds. Net gains of 0. 5 to 4. 2 pounds per acre (including recruitment) were found in 1956, while net losses of 3. 4 to 5. 8 pounds per acre occurred in 1957. Loss of biomass due to weight loss at spawning is unavoidable. Recruitment of wild stocks planted as advanced fry overcame losses in 1956. Recruitment of naturally spawned trout in 1957 was not sufficient to overcome loss of biomass. (Auth.)

**4345.** Pearce, William A. 1961. THE UPPER ST. LAWRENCE RIVER ICE FISHERY. New York Fish and Game Journal, Vol. 8, No. 1, pp. 31-36.

A creel census during the winters of 1958-59 and 1959-60 provided much needed information on ice fishing in the upper 45 miles of the St. Lawrence River in New York State. Pike was the primary species fished for. Fishing pressure over the area as a whole was relatively light. A total of 1, 479 anglers were observed and 1, 280 of them were checked. They fished an average of four lines and, when checked, had caught 673 legal pike or one for each 8. 1 hours fished. The ratio of male to female pike caught was 1:2. 4. The ratio during the last month of season for the two winters was 1:2. 3. Yellow perch was the only other species caught; fishing for them was usually incidental to fishing for pike. Some 63 per cent of the anglers had driven over 40 miles to reach their fishing grounds. There was no indication of overharvest of pike, and present regulations appear to be satisfactory in light of what is known about the over-all pike population in the area, (Auth. abst.)

**4346.** Poole, John C. 1961. AGE AND GROWTH OF THE FLUKE IN GREAT SOUTH BAY AND THEIR SIGNIFICANCE TO THE SPORT FISHERY. New York Fish and Game Journal, Vol. 8, No. 1, pp. 1-18.

The age of fluke collected in Great South Bay was determined from annular markings on the otolith bone (sagitta). Growth was back-calculated according to the annuli for 357 fish taken in 1958 and 1959. Female fish grew significantly faster than males, reaching mean total lengths of 27. 1, 37. 7 and 46. 5 centimeters at the time of formation of Annuli I, II and III, respectively. The corresponding figures for male fluke were 25. 1, 32. 6 and 38. 7 centimeters. The sport fishery in 1958 and 1959 landed 1- and 2-year-old fluke primarily. These two age groups comprised 77 per cent of the catch in 1958 and 90 per cent in 1959. The sport fishery was dependent almost directly upon the success of spawning in the previous year, for 45 per cent of the fish taken by hook and line in 1958 and 66 per cent of those taken in 1959 were 1 year old. . This dependence upon 1-year-olds provides evidence that marked annual fluctuations in abundance are due chiefly to differences in spawning success from year to year. (Auth. abst.)

**4347.** Dumas, Richard F. 1961. EFFECT OF LIGHT, DIET, AND AGE OF SPAWNING BROWN TROUT UPON CERTAIN CHARACTERISTICS OF THEIR EGGS AND FRY. New York Fish and Game Journal, Vol. 8, No. 1, pp. 49-56.

Studies were carried on to determine the effect of light, diet and age of spawning fish on the physical and chemical characteristics of developing brown trout

eggs. It was found that all three factors influenced the relative weight and size of eggs, but that the nutrition and age of breeders were the only ones, of those studied, that affected the chemical composition of eggs and fry. (Auth. abst.)

**4348.** Loeb, Howard A., and William H. Kelly. 1961. LABORATORY MANUFACTURE OF FISH BAITS FOR EXPERIMENTAL PURPOSES. New York Fish and Game Journal, Vol. 8, No. 1, pp. 64-65.

An efficient method of making small lots of experimental baits has been developed at the Fish Laboratory at Livingston Manor (N. Y.) and has been adapted for use at the Fish Disease Laboratory at Rome (N. Y.)

The baits vary in size from 1/8 to 1/2 inch in diameter and have been used to study the feeding habits of carp in aquaria and ponds and to test the effect of various medicines on diseased trout. The finished dry baits are quite uniform in size and shape and are easily stored. (Auth.)

**4349.** Limbaugh, Conrad. 1961. LIFE-HISTORY AND ECOLOGIC NOTES ON THE BLACK CROAKER. California Fish and Game, Vol. 47, No. 2, pp. 163-174.

Many features in the life history and ecology of the black croaker, Cheilotrema saturnum (one of the eight native sciaenids of California) have been elucidated through underwater observations, rearing in aquaria and literature review.

The species ranges from the Santa Barbara Channel (about Pt. Conception) in California to Santa Maria Bay, Baja California. Related forms occur in the Gulf of California and off Peru. Adults have been reported from bays and sloughs as well as the open coast, but were observed only while diving along rocky coasts, in water 4 to 150 feet deep, with their abundance centering at about 21 feet. They are generally very retiring in habits, chiefly frequenting caves and crevices. Juveniles, smaller than 88 mm. (3.5 inches) in standard length, were noted in depths of 4 to 18 feet with a concentration at about 9.

Adult black croakers undergo changes in coloration of apparent adaptational significance. The nocturnal pattern is distinct from the diurnal. The coloration changes remarkably between the attainment of standard lengths of 14 to 120 mm. The juveniles strikingly resemble the young of the California sargo, Anisotremus davidsoni, and the California salema, Xenistius californiensis, and the young of these three species school together.

Black croakers appear to feed exclusively on crustaceans. They mature at a standard length of about 22 cm. (9 inches) and spawn in late spring and early summer. A total length of 18 inches has been attributed to the species but most authors give the maximum size as 15 inches. The largest ones observed in diving were estimated to be 14 inches long. A 14.25-inch female checked by the Department of Fish and Game weighed slightly more than a pound and a half.

Published statements indicate black croakers were formerly more abundant, especially in non-polluted bays. They have been regarded as now rare, but diving observations disclosed considerable abundance. The black croaker is a palatable food fish, but the development of any considerable fishery for it seems unlikely. (Auth. summ.)

**4350.** Pinkas, Leo. 1961. DESCRIPTIONS OF POSTLARVAL AND JUVENILE BONITO FROM THE EASTERN PACIFIC OCEAN. California Fish and Game, Vol. 47, No. 2, pp. 175-188.

Postlarvae and juvenile Sarda chiliensis, 16.7 to 200.9 mm. are described and illustrated and the localities of their capture recorded.

Specific identification was based upon: number of vertebrae; kind and number of teeth in the lower jaw; number of rakers on the lower limb of the first gill arch; and the presence of posterior gill teeth. All of these characteristics serve to distinguish S. chiliensis from S. velox, the other eastern Pacific bonito.

Two unique and distinctive features of diagnostic value in separating Sarda chiliensis from other larval scombrids (except S. velox) are: all-black pelvic fins in combination with an almost all-black first dorsal fin; and the four or five spines above each eye of the postlarvae. (Auth. summ.)

**4351.** Cordone, Almo J., and Don W. Kelley. 1961. THE INFLUENCES OF INORGANIC SEDIMENT ON THE AQUATIC LIFE OF STREAMS. California Fish and Game, Vol. 47, No. 2, pp. 189-223.

There is abundant evidence that sediment is detrimental to aquatic life in salmon and trout streams. The adult fishes themselves can apparently stand normal high concentrations without harm, but deposition of sediments on the bottom of the stream will reduce the survival of eggs and alevins, reduce aquatic insect fauna, and destroy needed shelter. There can scarcely be any doubt that prolonged turbidity of any great degree is also harmful.

The question, "how much sediment is harmful?" has not yet been answered since most workers have failed to measure the amounts of sediment.

Field investigations with electric sampling gear in the Sierra Nevada over the past years have led us to develop the maxim, "Clean stream bottoms mean good trout populations." By "clean" we mean lacking much sand.

Many of the sediment problems reported in the literature are the result of large-scale discharges of sediment from gravel washing or mining operations. These are often spectacular but probably less important than the gradual deposition being caused by erosion.

The increasing activity of man on our mountain watersheds in California is resulting in obviously increased erosion and sediment deposition. Our failure to recognize that even small amounts of sediment may be harmful may well result in gradual destruction of the majority of our streams, while we work feverishly to solve more obvious and spectacular problems.

We have been impressed by two facts. First, there has been sufficient work done to establish the fact that sediment is harmful to trout and salmon streams; the only references found to the contrary (Ward 1938a and 1938b) have been adequately criticized. Second, our experience in the Sierra Nevada indicates that the bulk of the damage there is unnecessary. It can be prevented with known land use methods, often with little or no additional expense. Much of it is the result of carelessness.

More than anything else we need to develop a philosophy of land husbandry that will avoid the creation of untreated and running sores on the earth's surface. Man must acquire a responsibility to future generations that matches the power he has gained through the development of heavy machinery.

Our observations in the field and our review of the existing literature leads us to the unshakable conclusion that unless this can be done many of our trout streams will be destroyed by the deposition of sediment. (From auth. summ.)

**4352.** Joseph, Edwin B., William H. Massmann, and John J. Norcross. 1960. INVESTIGATIONS OF INNER CONTINENTAL SHELF WATERS OFF LOWER CHESAPEAKE BAY. PART I. --GENERAL INTRODUCTION AND HYDROGRAPHY. Chesapeake Science, Vol. 1, Nos. 3-4, pp. 155-167.

A series of monthly exploratory cruises into the neritic waters of the Atlantic Ocean adjacent to lower Chesapeake Bay were initiated late in 1959 to: (a) locate the eggs and larvae of fishes spawning in the area; and (b) to trace the transport of these stages by surface and subsurface currents into the Chesapeake Bay system. This paper will serve as an introduction to a proposed series describing the results of the cruises.

The survey area, which covers 50 nautical miles offshore and 60 miles in a north-south direction, is the neritic zone lying within the 20 fathom contour and extending from False Cape on the south to Wachapreague Inlet at the northern limit. Twenty-two offshore stations in addition to three stations in lower Chesapeake Bay were sampled monthly with surface and bottom plankton nets. Routine hydrographic data were taken at each station.

Surface and bottom water samples from the cruises of December through May indicated these preliminary points: From December through March the water column was essentially homogeneous with respect to temperature. Vernal warming began in April and thermal stratification progressed through May. The distribution of salinities was generally coastal in character with isohalines parallel to the coastline. The discharge of effluent from Chesapeake Bay produces frequent deviations from the normal coastal pattern. In general, the major component of the discharge from Chesapeake Bay passes out around Cape Henry and proceeds southward.

Drift bottle returns indicated that the survey area is crossed by a southerly drift having a velocity of 10 to 14 miles per day. (Auth. abst.)

**4353.** Pore, Arthur. 1960. CHESAPEAKE BAY HURRICANE SURGES. Chesapeake Science, Vol. 1, Nos. 3-4, pp. 178-186.

Storm surges of hurricanes passing west of Chesapeake Bay are compared to surges generated by hurricanes passing east of the bay. The surges of each type storm are quite different, as the western storms cause highest surges in the northern portion of the bay and the eastern storms produce highest surges in the southern portion. (Auth. abst.)

**4354.** Dovel, William. 1960. LARVAL DEVELOPMENT OF THE OYSTER TOADFISH, OPSANUS TAU. Chesapeake Science, Vol. 1, Nos. 3-4, pp. 187-195.

Detailed illustrations of the early larval development of the oyster toadfish, Opsanus tau (Linnaeus), are presented for the first time to show variation in size and morphology, sequence of fin formation and yolk absorption.

Eggs, 5 mm in diameter, were attached to a substrata by an adhesive disk and hatched into larvae about 7.0 mm T. L. They were studied through essentially prolarval growth until about 19.0 mm T. L. and 20 days old.

Prominent features were the large stalk-like yolk sac and a pectoral-pelvic fin apparatus position shift. The color pattern was apparent at 16.4 mm.

Head, snout-anus and eye lengths compared with total length showed proportional growth. Body depth-total length showed non-proportional growth.

The full complement of various fin rays was apparently attained at these total lengths: pectoral--17.1 mm; spinous dorsal - 10.8 mm; soft dorsal - 12.8 mm; anal - 12.8 mm; and caudal - probably at 18.0 mm. (Auth. abst.)

**4355.** Nichols, Paul R. 1960. HOMING TENDENCY OF AMERICAN SHAD, ALOSA SAPIDISSIMA, IN THE YORK RIVER, VIRGINIA. Chesapeake Science, Vol. 1, Nos. 3-4, pp. 200-201.

To determine the homing tendency of American shad in the York River, Virginia, 313 fish were tagged on the spawning ground in the spring of 1959. During the following spring, 14 marked fish were recaptured within the York River system and 5 in the vicinity of tagging. None was recaptured on the spawning ground of any other river, suggesting that shad having spawned once in this river system would return to spawn again. (Auth. abst.)

**4356.** Schwartz, Frank J. 1960. MEASUREMENTS AND THE OCCURRENCE OF YOUNG SANDBAR SHARK, CARCHARHINUS MILBERTI, IN CHESAPEAKE BAY, MARYLAND. Chesapeake Science, Vol. 1, Nos. 3-4, pp. 204-206.

Measurements of five young specimens of the sandbar shark Carcharhinus milberti, 614-747 mm in length, captured in Maryland's Chesapeake Bay in 1958-1959 are presented. Variations in fin sizes, body proportions and growth are compared with detailed literature records. These young specimens were shorter and stouter than known. Adult C. milberti, although reported sighted, have yet to be

captured in the upper Chesapeake Bay, although the capture of these specimens indicates the bay is a spawning area. (Auth. abst.)

**4357.** Mansueti, Romeo J. 1960. RESTRICTION OF VERY YOUNG RED DRUM, SCIAENOPS OCELLATA, TO SHALLOW ESTUARINE WATERS OF CHESAPEAKE BAY DURING LATE AUTUMN. Chesapeake Science, Vol. 1, Nos. 3-4, pp. 207-210.

Young-of-the-year red drum, ranging from 20-90 mm total length and one to several months old, were found to be restricted to a shoal estuarine habitat in Chesapeake Bay during autumn months. Extensive trawl data from deep water during autumn and winter illustrate their absence from deep water throughout the bay. It is postulated that beginning in September planktonic Sciaenops are carried from the Atlantic ocean spawning area into Chesapeake Bay by the net upstream movements of deep subsurface water currents of high density. After metamorphosis to a free-swimming stage, the young restrict their activities to shallow waters which may be important but temporary nursery areas. They may then rapidly descend to the ocean in early winter. Evidence is presented to show that the spawning may begin in August off the mid-Atlantic, a month earlier than was formerly believed. (Auth. abst.)

**4358.** Schwartz, Frank J. 1960. RECENT ADDITIONS TO THE UPPER CHESAPEAKE BAY FISH FAUNA. Chesapeake Science, Vol. 1, Nos. 3-4, pp. 210-212.

Nineteen species of fish new or of recent occurrence (1957-60) to the fish fauna of the upper portion of Chesapeake Bay, Maryland, are presented. Abundance, size, lateness of occurrence, and/or ecological conditions are discussed. (Auth. abst.)

**4359.** Holt, S. J., J. A. Gulland, C. Taylor, and S. Kurita. 1959. A STANDARD TERMINOLOGY AND NOTATION FOR FISHERY DYNAMICS. Bull. Japanese Soc. Sci. Fish., Vol. 25, No. 3, pp. 245-248; Biological Abstracts, Vol. 36, No. 9, Abst. No. 25858. 1961.

Twenty-six symbols for terminology and notation for fishery dynamics are given with definitions in English, and summary terms in English, German, and Japanese (Roman alphabet). (G. G.)

**4360.** Andrew, F. J., and G. H. Geen. 1960. SOCKEYE AND PINK SALMON PRODUCTION IN RELATION TO PROPOSED DAMS IN THE FRASER RIVER SYSTEM. Internatl. Pacific Salmon Fish. Comm. Bull. 1. 1-259; Biological Abstracts, Vol. 36, No. 9, Abst. No. 26238. 1961.

Extensive dam construction recently proposed for the Fraser River system would, on the basis of present knowledge, seriously deplete the sockeye and pink salmon populations. To contribute towards a better understanding of the complicated nature of problems that would be involved in preserving sockeye and pink salmon if dams were constructed in the Fraser River system, and to contribute towards the possible solution of these problems, this report presents a review of available information concerning methods of passing adult and juvenile salmon over dams, the possible effects of environmental changes on production of sockeye and pink salmon, and methods of artificially propagating these species. Efficient passage of adult salmon over dams would be a critical problem in the Fraser River system in view of the large numbers of fish involved and the known intolerance of many races to migratory delay. Because methods have not been developed for safely passing large numbers of seaward migrants over the proposed Fraser River dams, a significant proportion of these fish would be killed in passage over spillways and through turbines. Other obvious effects of dam construction, such as creation of reservoirs, inundation of spawning areas, and alteration of lake rearing areas would also seriously reduce productivity. The effects of subtle environmental changes, such as altered temperatures and discharges, are more difficult to evaluate but, in view of the sensitive relationship between the fish and their environment, such changes could have serious adverse effects on productivity. Maintenance of the delicately balanced environmental conditions to which Fraser River sockeye and pink salmon have become adapted appears to be a prerequisite for maximum production. Alteration of the natural environment, an inevitable consequence of dam construction, could result in seriously reduced production of Fraser River sockeye and pink salmon. On the basis of present knowledge, hatcheries, artificial spawning grounds, and other artificial production methods in the downriver area would not compensate for loss of natural upriver production of sockeye and pink salmon. Extensive basic and applied research in salmon biology and fish-power problems is now being undertaken but there is no justification for expecting early solutions to all of the particularly complex Fraser River fish-power problems. (Auth. abst.)

**4361.** Dannevig, Alf. 1960. GOVERNMENT HATCHERY AT FLØDEVIGEN, REPORT, 1952-56. (STATENS UTKLEKNINGSANSTALT VED FLØDEVIGEN, BERETNING 1952-56.) Arsberetning vedkommende Norges Fiskerier 1959(14): 1-26; Biological Abstracts, Vol. 36, No. 9, Abst. No. 26250. 1961.

This 5-year progress report discusses hatching, rearing, and planting cod (Gadus morrhua), lobster (Homarus vulgaris), oysters (Oster edulis), and mussels at Flødevigen. It also summarizes investigations on effect of pressure on survival of young cod and flounder, methods for distinguishing fish strains and populations, effect of temperature on hatching and growth, occurrence and survival of eggs and fry in nature, distribution of herring (Clupea harengus), sprat (Clupea sprattus), and cod in the North Sea, location of schools and fishing methods for herring and sprat, and the effect of temperature on the habits of mackerel (Scomber scombrus), and on the growth and abundance of lobster. (R. P. E.)

**4362.** Green, H. B., and Ross E. Hutchins. 1960. LABORATORY STUDY OF TOXICITY OF IMPORTED

FIRE ANTS TO BLUEGILL FISH. Jour. Econ. Ent. 53(6): 1137-1138; Biological Abstracts, Vol. 36, No. 9, Abst. No. 26260. 1961.

During the spring of 1960, large numbers of bluegill fish were found dead in ponds in South Mississippi and Alabama. Upon dissection, the stomachs of these fish were found to be filled with fire ants, Solenopsis saevissima var. richterii, a newly-established pest. Unsuccessful attempts were made to feed living and dead fire ants to bluegill fish under both field and laboratory conditions. Five grams of fire ants were then macerated in a blender and injected directly into the stomachs of bluegills, ranging from 0.1 to 0.3 pounds in weight, and all were killed. As a check, other fish were similarly treated with macerated grasshoppers. These fish were not affected. Macerated fire ants were also injected into the body cavities of bluegills. These test fish were also killed. It thus appears that the number of fire ants found in the dead fish in ponds in the spring of 1960 were more than sufficient to have killed them. It remains to be discovered under what natural conditions wild fish will feed upon fire ants. (R.E.H.)

**4363.** Magnin, E., and G. Beaulieu. 1960. MOVEMENTS OF TAGGED STURGEONS IN THE SAINT LAWRENCE RIVER. (DEPLACEMENTS DES ESTURGEONS (ACIPENSER FULVESCENS ET A. OXYRHYNCHUS) DU FLEUVE SAINT-LAURENT D'APRES LES DONNEES DU MARQUAGE.) Naturaliste Canadien 87(11): 237-252; Biological Abstracts, Vol. 36. No. 9, Abst. No. 26271. 1961.

Report of a 15-year survey. Of 1507 tagged yellow sturgeons (Acipenser fulvescens) 115 were recaptured. The young sturgeon is sedentary; its movements rarely exceed 30 miles (48 Km) and are generally less than 10 miles (16 Km) from the site of tagging. Of 2995 immature tagged specimens of the black sturgeon (A. oxyrhynchus) 592 were recaptured. The findings indicate that the young A. oxyrhynchus progressively move towards the sea. But at different levels they can still move upstream or downstream in search of food or proper temperature or tidal conditions, until the time they enter the sea. One individual had migrated more than 900 miles; 17, more than 100 miles. (G.R.B.)

**4364.** Needham, Paul R., and Richard Gard. 1959. RAINBOW TROUT IN MEXICO AND CALIFORNIA. Univ. California Publ. Zool. 67(1): 1-124; Biological Abstracts, Vol. 36, No. 9, Abst. No. 26279. 1961.

Variation in 306 specimens of rainbow trout, Salmo gairdnerii Richardson, of 17 different population samples collected from northern California to near Ciudad Durango, Durango, Mexico, is reported. The data on 12 meristic and 28 linear characters are analyzed and plotted graphically. These graphs generally follow the classical arrangement that is usually observed, where the more northerly forms possess more meristic elements than the same species living in warmer waters. However, they differ from this arrangement by the fact that the rainbows from the Verde, Sinaloa, and Culiacan drainages produced the lowest counts toward, but not at, the southern limits of their range. This pattern is definitive in 8 meristic and 1 linear character, weakly outlined in 8, and slightly reversed in 3. In 20 other characters, all linear, no particular pattern is evident. Significant coefficients of difference are obtained in one or more characters between almost any two groups of rainbow trout described here. Applications of the 75% rule would permit naming of many of these as subspecies. Since the measurable differences displayed by the population samples analyzed here seem largely extrinsic in nature, even though these are under partial intrinsic control, the authors have described them without nomenclatorial separation. (M.B.P.)

**4365.** Sundnes, G. 1960. ANOTHER MODIFICATION OF THE SCHOLANDER-ROUGHTON TECHNIQUE: NITROGEN DETERMINATION IN FISH BLOOD. Fiskeridirekt. Skrifter Ser. Havunders, 12(9): 1-6. 1960; Biological Abstracts, Vol. 36, No. 9, Abst. No. 26292. 1961.

The described method was applied satisfactorily to blood of Salmonide and Gadide fishes. (R.P.E.)

**4366.** van Someren, Vernon D., and Peter J. Whitehead. 1959. THE CULTURE OF TILAPIA NIGRA (GUNTHER) IN PONDS. II. THE INFLUENCE OF WATER DEPTH AND TURBIDITY ON THE GROWTH OF MALE T. NIGRA. East African Agric. Jour. 25(2): 66-72; Biological Abstracts, Vol. 36, No. 9, Abst. No. 26298. 1961.

In ponds which have been stocked with equivalent numbers of male T. nigra, and which have shown comparable survival rates over a period of six months, the growth of fish has been markedly better in those ponds in which the water is shallow (average depth one foot), as opposed to deep (average depth two feet), and clear as opposed to turbid. At the two extremes of shallow/clear and deep/turbid, the fish in the former showed an advantage of 25% greater length, and 43% greater weight at the end of the six months. The main feature responsible for these differences is almost certainly water temperature. Ponds which are shallow and clear maintain their water at higher temperatures for longer each day than deep or turbid ponds. Such higher temperatures will in themselves induce faster growth directly, as is well known for other species of fish. At the same time, however, other factors are probably operative; shallow clear ponds will allow of greater light penetration, and hence better diatom growth on the bottom mud, diatoms forming the main food digested by T. nigra. Further shallow ponds are probably not subject to nocturnal stratification in temperature and dissolved gases which lead to curtailment of fertility. The turbidity of ponds is greatly increased if breeding is allowed, due to disturbance of the bottom mud by nesting fish, and though males in isolation will make nests, breeding is prevented and disturbance minimal. Thus monosex ponds run much clearer than breeding ponds, which in turn enhances the better growth of males under monosex

culture conditions. These findings have immediate practical application, since it is much cheaper to build shallow bunds on a flat area to retain water at a maximum depth of not more than one foot than to construct standard three- to four-foot deep fish ponds, and with such shallow ponds elaborate outlet systems are not required for drainage. However predation by birds or other animals may be heavier in shallow ponds than in deep water. (Auth. abst.)

**4367.** van Someren, V. D., and P. J. Whitehead. 1960. THE CULTURE OF TILAPIA NIGRA (GUNTHER) IN PONDS. III - THE EARLY GROWTH OF MALES AND FEMALES AT COMPARABLE STOCKING RATES, AND THE LENGTH/WEIGHT RELATIONSHIP. East African Agric. Jour. 25(3): 169-173; Biological Abstracts, Vol. 36, No. 9, Abst. No. 26299. 1961.

At equivalent stocking rates under comparable pond conditions, isolated male Tilapia nigra show a faster growth rate than isolated females. This sexual dimorphism in growth is probably genetically controlled, and is also characteristic of the closely related species T. mossambica and others of this group. This superiority in male growth is the basis of the monosex culture technique, and probably occurs under all conditions. Length for length, isolated males also show a greater weight per fish than do mixed breeding fish. (Auth. abst.)

**4368.** van Someren, V. D., and P. J. Whitehead. 1960. THE CULTURE OF TILAPIA NIGRA (GUNTHER) IN PONDS. IV. THE SEASONAL GROWTH OF MALE T. NIGRA. East African Agric. and Forest Jour. 26(2): 79-86; Biological Abstracts, Vol. 36, No. 9, Abst. No. 26300. 1961.

The increase in length of male Tilapia nigra decreases asymoptotically as the fish grows older, and varies from month to month according to fluctuations in external environmental conditions, weight being more affected than length in the latter instance. The most important external factor is undoubtedly the water temperature at which the fish live; rises and falls in mean temperatures of only a few degrees cause marked increases or decreases in weight achieved, respectively. Water temperature is in itself much affected by other weather conditions, and is not necessarily maximal in months of maximum sunshine owing to increased wind speeds and evaporation rate in such months. Rainfall may in itself also affect fish growth directly, though this is not fully established yet. In the environmental conditions present at Sagana, male T. nigra show two good growing periods and two poor growth periods every year. (Auth. abst.)

**4369.** Klement, A. W., Jr., and I. E. Wallen. 1960. A SELECTED LIST OF REFERENCES OF MARINE AND AQUATIC RADIOBIOLOGY. U. S. Atomic Energy Comm. (Rept.) TID-3903. 1-37. 1960; Biological Abstracts, Vol. 36, No. 10, Abst. No. 29211. 1961.

**4370.** Clampitt, Philip T., Elizabeth L. Waffle, and Richard V. Bovbjerg. 1960. AN ECOLOGICAL RECONNAISSANCE OF THE BOTTOM FAUNA, MILLERS BAY, LAKE WEST OKOBOJI. Proc. Iowa Acad. Sci. 67: 553-568; Biological Abstracts, Vol. 36, No. 10, Abst. No. 29578. 1961.

The bottom fauna and related ecological factors were investigated in a bay of Lake West Okoboji, Iowa, during the summer of 1959. Two contiguous areas were compared: (1) a relatively small, shallow bay largely enclosed by land and partially separated by a narrow sand spit from (2) a larger, deeper bay opening into the major lake basin. Data include particle size analysis and organic content of substratum, and qualitative and quantitative distribution of more than 50 species of macroscopic bottom animals. Density and bio-mass of animals were calculated at 14 stations. Chironomids (Diptera) were the dominant group in the study area. Distribution of chironomid genera, as well as of other invertebrate groups, was found to be related to depth, vegetation, and substratum characteristics. (Auth. abst.)

**4371.** Farrugia-Fougerouse, Gisele. 1960. CONTRIBUTION TO THE KNOWLEDGE OF THE ORIGIN, OF THE METABOLISM, AND SOME BIOLOGICAL PROPERTIES, FOR ALGAE, OF THE MINERAL SALTS AND ORGANIC COMPOUNDS DISSOLVED IN BODIES OF NATURAL STANDING WATER. (CONTRIBUTION A LA CONNAISSANCE DE L'ORIGINE, DU METABOLISM, ET DES PROPRIETES BIOLOGIQUES, POUR LES ALGUES, DES SELS MINERAUX ET COMPOSES ORGANIQUE DISSOUS DANS LES COLLECTIONS D'EAU NATURELLES STAGNANTES.) Hydrobiologia 16(1): 1-80; Biological Abstracts, Vol. 36, No. 10, Abst. No. 29580. 1961.

The study was carried out over a period of 12 months and monthly samples were collected from a number of different ponds in the Rambouillet region of France. Counts of the aerobic bacteria present in the samples were made and over half the population consisted of pigmented heterotrophic forms. Seasonal variations in the bacterial population are tabulated and the causes of these variations are discussed. The samples were also analyzed for pH, total organic matter, ammonia, nitrite, nitrate, phosphate, Ca and Mg, Fe, alkalinity, sulphate and total dissolved solids. The origin of the various compounds and the causes of the seasonal variations observed are discussed. Attempts were made also to culture a wide variety of algae in the samples collected. The ability to support cultures varied from sample to sample and reasons for this are put forward. The phytoplankton, zooplankton, temperature and bacterial count during each month for each of the ponds studied are summarized in a table and after a discussion of the variations seen it is suggested that the dissolved organic substances present in the water are very important in controlling the animal and plant populations in the ponds. (K. E. M.)

**4372.** Isabel, W. Smith. 1961. A DISEASE OF FINNOCK DUE TO VIBRIO ANGUILLARUM. Jour. Gen. Microbiol. 24(2): 247-252; Biological Abstracts, Vol. 36, No. 10, Abst. No. 29590. 1961.

A disease of finnock (immature Salmo trutta) is described. The causal organism was found to be a Gram-negative, motile, curved rod which was also pathogenic to eels, perch, plaice and saithe. On comparison with other pathogenic vibrios from fish, it was apparent that the organism was a variant of Vibrio anguillarum so the name V. anguillarum type C is suggested. (Auth. abst.)

**4373.** Srivastava, Vinay K. 1959. STUDIES ON FRESH WATER BOTTOM FAUNA. III. THE CORRELATION BETWEEN BOTTOM FAUNA AND THE FOOD OF FISHES. Proc. Natl. Acad. Sci. India 29(4): 217-223; Biological Abstracts, Vol. 36, No. 10, Abst. No. 29604. 1961.

A rich and varied assemblage of different organisms present in north-Indian freshwater lakes. Oligochaetes, Chironomus larvae, insect larvae and mollusks formed the main bulk of the bottom catches. The stomach contents (food-consumed in nature) of the fishes, which consisted chiefly of Chironomus larvae, oligochaetes, mollusks, insects, small pieces of aquatic weeds, fish scales along with some other burrowers, clingers, crawlers and hiders among the bottom materials, showed marked qualitative and quantitative variations with the succession of season, and the former showed a good correlation with the bottom catches. (Auth. abst.)

**4374.** Sulya, L. L., B. E. Box, and Gordon Gunter. 1961. PLASMA PROTEINS IN THE BLOOD OF FISHES FROM THE GULF OF MEXICO. Amer. Jour. Physiol. 200(1): 152-154; Biological Abstracts, Vol. 36, No. 10. Abst. No. 30209. 1961.

The plasma proteins of 14 families and 26 species of fishes from Gulf coast marine waters have been studied electrophoretically. Analbuminemia has been observed not only in elasmobranchs, but in gars and some clupeids, as well as in two species of higher fishes. Analbuminemia is characteristic of the lower fishes and gradually disappears as fishes become more complex, but not entirely, since the condition exists in a few higher fishes. In addition, several species were lacking in the alpha-I-globulin fraction. There is an increase in complexity of plasma proteins from lower to higher fishes. The plasma proteins show specific differences and may be quite different in closely related fishes. The total plasma protein is lower than in mammals. (Auth. abst.)

**4375.** Olivereau, Madeleine. 1960. A VOLUMETRIC STUDY OF THE ANTERIOR INTERRENAL GLAND DURING THE MIGRATION OF SALMO SALAR L. (ETUDE VOLUMETRIQUE DE L'INTERRENAL ANTERIEUR AU COURS DE LA SMOLTIFICATION DE SALMO SALAR L.) Acta Endocrinol. 33(1): 142-156; Biological Abstracts, Vol. 36, No. 10, Abst. No. 30288. 1961.

A planimetric evaluation of the interrenal area dispersed in the cephalic lymphoid kidney of salmon showed a significant hypertrophy (100%) in absolute and relative volume during migration. These changes are associated with activity of the fuchsinophilic cells of the middle glandular region of the pituitary gland, and by a functional activation of the thyroid gland. (L. Z. McF.)

**4376.** Tsukuda, Hiroko, and Wataru Ohsawa. 1958. THE HEAT AND COLD COMA TEMPERATURES IN LEBISTES RETICULATUS AS DETERMINED BY RAISING AND LOWERING WATER TEMPERATURE AT CONSTANT RATES. Jour. Inst. Polytech. Osaka City Univ. Ser. D Biol. 9: 69-76; Biological Abstracts, Vol. 36, No. 10, Abst. No. 30963. 1961.

By means of a newly designed apparatus which facilitates raising and lowering the water temperature at a given constant rate, the heat and cold coma temperatures of Lebistes reticulatus were determined as a function of the rate of temperature change. The heat coma temperature falls and the cold coma temperature rises hyperbolically as the rate decreases. The heat coma temperature--rate relation appears to be composed of two curves characterized by different critical temperatures. (Auth. abst.)

**4377.** Cohen, Daniel M. 1959. THE SCIENTIFIC NAME OF THE COMMON COD. Jour. Conseil Perm. Internatl. Explor. Mer. 25(1): 50-52; Biological Abstracts, Vol. 36, No. 10, Abst. No. 32591. 1961.

The original descriptions of Gadus callarias and Gadus morhua first appeared on the same page. When it was realized that the two names applied to the same species confusion arose as to which name should properly be used. The International Commission on Zoological Nomenclature placed Gadus on The Official List of Generic Names in Zoology and morhua, as published in the combination Gadus morhua, on The Official List of Specific Names in Zoology. They also decided that once a specific name is placed on the List it is to be used in preference to any other name, even if it is found not to be available or not the oldest name for the species; unless the Commission otherwise directs. The scientific name of the common cod should therefore stand as Gadus morhua Linnaeus 1758. (Auth. abst.)

**4378.** Williams, F. 1960. ON SCOMBEROMORUS LINEOLATUS (C. V.) 1831, FROM BRITISH EAST AFRICAN WATERS (PISCES, SCOMBRIDAE). Ann. and Mag. Nat. Hist. 3(27): 183-192; Biological Abstracts, Vol. 36, No. 10, Abst. No. 32605. 1961.

This is one of the most important food fishes of the region, known to fishermen as "kanadi" (Kiswahili) or "bowrega" (Bajune). It was previously identified only as to genus, but is now identified as S. lineolatus, and is here fully redescribed.

**4379.** Ali, M. A., P. Coper, and W. R. Stevenson. 1961. CORRELATION OF MORPHOLOGICAL AND INTRA-OCULAR MEASUREMENTS IN THE ATLANTIC SALMON (SALMO SALAR) YEARLING. Journal of the Fisheries Research Board of Canada, Vol. 18, No. 2, pp. 259-272.

In the Atlantic salmon yearling, correlation among various morpholotical measurements is of a higher order than correlation of various intra-ocular measurements. While the latter correlation

is positive, it is not of a high enough order to serve as a useful predictive device. Correlation between intra-ocular measurements from the left and the right eyes is also of a low order. (Auth. abst.)

**4380.** Christensen, Jørgen Møller. 1960-61. THE STOCK OF SOLES SOLEA SOLEA AND THE SOLE FISHERY ON THE DANISH NORTH SEA COAST. Meddelelser Fra Danmarks Fiskeri - og Havundersøgelser, Vol. 3, Nos. 1-6, pp. 19-63.

The Danish sole fishery in the North Sea is carried on by gillnet and trawl. The fishery takes place mainly inside the 40 m curve in the period from April till August, when the soles occur in the coastal area in connection with the spawning.

Due to the different mesh sizes the two gear used tax different parts of the population. The trawl catches contain up to 47% soles below the legal size (smaller than 24.5 cm), while the soles of legal size are distributed with 61% in the group 24.5 cm--29 cm and 39% in the group 30 cm--50 cm. The gillnet catches contain from 1-15 % soles below legal size, and the soles of legal size are distributed with 17% in the group 24.5 cm--29 cm and 83% in the group 30 cm--50 cm.

Soles caught in gillnets belong to the age groups IV-IX, and the catches mainly consist of gr. V and gr. IV. The trawl catches mainly comprise soles of gr III and gr. IV as far as males and immature females are concerned, while the size distribution of ripe females shows fairly the same picture for trawl and gillnet catches.

Males of gr. III were strongly predominant in the fishery area in 1959 relative to gr. IV.

An investigation of the composition of the population showed that males and females, to a certain extent, keep separate in the period just before spawning, that the males occur mainly to the west and to the north, and that soles of both sexes are bigger and older to the west and to the north in the fishing area.

On basis of a catch effort statistics in connection with the investigation of the composition of the population, and information from the fishermen of the positions of the fishery it has been possible to fix the time for the spawning in 1959 and the location of one spawning area. Spawning seems to be fairly concentrated in time as well as in place.

An investigation in the Waddensea showed that the gr. 0 soles arrive at the growth area in July and leave it definitely as gr. I in August-October next year. The soles in the Waddensea are especially abundant at the mouth of Varde A, where the salinity is low. (Auth. summ.)

**4381.** Mantelman, I. I. 1960. DISTRIBUTION OF THE YOUNG OF CERTAIN SPECIES OF FISH IN TEMPERATURE GRADIENTS. Translation Series, No. 257, Fisheries Research Board of Canada, Biological Station, Nanaimo, B. C., 67 pgs.

By studying the distribution of fish in an experimental temperature gradient, it was established that there is temperature zone characteristic for a given species of fish--the zone in which the fish occurs most frequently when given a free choice; this has been designated the selected temperature:

For young rainbow trout the selected temperature zone, that within whose limits 72% to 97% of the fish used in the experiments are concentrated, is found as a rule in the "warm" region of the temperature gradient and includes on the average the interval 13° to 19°. Independently of the season during which the experiments were carried out, the young fish as a rule avoided temperatures exceeding 21-22°. The young reacted negatively to temperatures lower than 8-9°, even in the case when they were held at a lower temperature prior to experiments (autumn of 1956, 5-6°; winter of 1957, 1-3°). According to these selected temperature data, the rainbow trout may be regarded as one of the species which are relatively thermophilic and stenothermic.

The temperature selected by young rainbow trout is somewhat lower during autumn.

There were also observed age differences in the reaction of fish to temperature: fish in the early stages of post-embryonic development react most quickly to temperature.

The temperature selected by the young rainbow trout does not depend on the size of the fish at a given age.

The temperature selected by the fish depends on their adaptation temperature. Considering rainbow trout, salmon and carp (aged up to 2 months), it was shown that holding these fish for a certain period of time at a temperature considerably different from the usual temperature conditions under which they live results in a shift of their selected temperature in the same direction.

Changes in selected temperature as a result of important changes in adaptation temperature take place in a very short time.

For the rainbow trout it is indicated that selected temperature is a stable characteristic for a population that has existed for a protracted period of time under given environmental conditions.

A rather fast change in selected temperature at the beginning of the adaptation process, and the return of this character to its norm as a result of protracted adaptation we regard as a manifestation of high adaptive plasticity of fish in respect to temperature.

Such lability, among poikilothermic animals, has great adaptive significance, since it makes possible the preservation of the normal vigour of the organism under conditions of a changing temperature regime. (From auth. concl.)

**4382.** Boetius, Jan. 1960-61. LETHAL ACTION OF MERCURIC CHLORIDE AND PHENYLMERCURIC ACETATE ON FISHES. Meddelelser Fra Danmarks Fiskeri-og Havundersøgelser, Vol. 3, Nos. 1-6, pp. 93-115.

It is demonstrated that fish (Lebistes) accumulate the poisonous ions from experimental solutions of mercuric chloride and phenylmercuric acetate. This causes a loss of mercury from the solutions, which also loose mercury in other ways. This involves special dispositions for the experiments in view of the necessity of constant experimental concentrations.

The relation between the concentration of poison and the survival-time (the CS-relation) has been examined for mercuric chloride and the fishes Tilapia, Eupomotis, Ambloplites, Lebistes, Salmo and Gasterosteus. A corresponding investigation has been made with phenylmercuric acetate and the three last-mentioned species.

The CS-relation for mercuric chloride is fundamentally the same for the 6 species examined. It is composed of two different functions, which in the double-logarithmic reproduction present two straight lines, each with its characteristic slope. The meeting point of the lines, the crack-point, is found at concentrations abt. 10-30 mg Hg/litre. For solutions weaker than the concentration corresponding to the meeting point the valid CS-relation is: $t_T \cdot C = k$, where $t_T$ is the survival-time of the fishes, C the mercury concentration of the solution and k a constant. It appears from this equation that mercuric chloride theoretically is infinitely toxic. As the poison is accumulating, the equation further tells that a certain quantity of mercury must be accumulated to create a lethal effect.

The CS-curve for phenylmercuric acetate shows a double-logarithmically rectilinear course and an unchanged slope throughout the whole range of concentration examined.

The poisonous action of mercuric chloride depends on the temperature. $Q_{10}$-values for Eupomotis were calculated to be 3.0 and 1.9, respectively, at the concentrations 5 and 30 mg Hg litre.

The toxic action of mercuric chloride depends on the weight of the experimental fishes. Experiments with Tilapia show that the reciprocal survival-time ("the velocity of dying") is proportional to the relative surface of the fish.

In sea water the toxic action of mercuric chloride decreases perceptibly (experiments with Gasterosteus). This phenomenon is discussed. However, phenylmercuric acetate in sea water seems to increase its toxicity.

An examination of the molecular conductance of mercuric chloride shows that the dissociation of this weak electrolyte is greatly accelerated by increasing dilution. There are strong reasons to suppose that the "cracking" of the CS-curve of mercuric chloride is due to the conditions of dissociation, so that the meeting point of the two lines corresponds to the concentration which indicates a complete dissociation of the substance.

Among the species examined Salmo and Gasterosteus seem to be particularly sensitive to mercuric chloride. In solutions of phenylmercuric acetate Salmo is particularly sensitive.

**4383.** Job, S. V. 1960. GROWTH AND CALORIFIC APPROXIMATION IN THE SPECKLED TROUT. Indian Journal of Fisheries, Vol. VII, No. 1, pp. 129-136.

The results obtained from a simple feeding experiment and the active oxygen consumption experiment showed that the metabolic rate can be equated with the calorific output in the speckled trout with reasonable agreement.

The oxygen consumption of a fish of 89 gm. over a period of two weeks at 17° C. was 8·8 litres (approximate). (Auth. summ.)

**4384.** Wuhrmann, K. 1959. CONCERNING SOME PRINCIPLES OF THE TOXICOLOGY OF FISH. Translation Series, No. 243, Fisheries Research Board of Canada, Biological Station, Nanaimo, B. C., 19 pgs.

By numerous experimental examples we have shown that the poisoning of fish by some substances frequently encountered in waste waters depends in large measure on conditions in which the toxic solutions act on the test fish. Only the relation between the concentration and response time is a measure characterizing a fish poison. The relation is changed when one varies the test conditions. The factors of particular importance are: the species of fish, the pH, the temperature and the oxygen tension in the toxic solution. The age of the fishes seems likewise to play a certain role.

We have explained the problem of the standardization of the toxicity-test for fish and make certain suggestions on the establishment of rules for testing. (Auth. summ.)

**4385.** Grøntved, Jul. 1960-61. TAXONOMICAL AND PRODUCTIONAL INVESTIGATIONS IN SHALLOW COASTAL WATERS. Meddelelser Fra Danmarks Fiskeri-og Havundersøgelser, Vol. 3, Nos. 1-6, pp. 1-17.

In the cove Ulvedybet in the eastern part of the Limfjord the rate of the primary production in the free water masses was estimated. The gross production amounted to 36 gr C/$m^2$ for the period 4/4-10/11, 1958. In other Danish shallow water localities the following figures are recorded for a whole year: 105 gr C/$m^2$ (Venø Bugt), 60 gr. C/$m^2$ (Karrebaeksminde Bugt), and 6 gr. C/$m^2$ (Dybsø Fjord). However, the gross production of the plankton per $m^3$ at the surface shows a higher rate in Ulvedybet than in any of the other localities mentioned.

In Dybsø Fjord with a vigorous growth of underwater macrovegetation the yield of this crop was estimated to 184 g dry matter per $m^2$ for the summer half year. Thus the productivity of this vegetation by far exceeds that of the plankton in this place. The macrovegetation in Ulvedybet, Venø Bugt, and Karrebaeksminde Bugt are poor, but no estimation of the yield has been made. Probably the productivity of the macrovegetation in these localities is less than that of the plankton populations.

In the period August-September the plankton in Ulvedybet is dominated by green and blue-green algae, whereas diatoms and dinoflagellates are of small importance quantitatively.

In course of plankton investigations in the estuary Seden Strand a Chaetoceros species referred to Ch. abnormis Pr.-Lavrenko was observed. It belongs to the Ch. subtilis-form circle which is treated at some length in the paper. Another plankton species new to our waters Gymnodinium splendens Lebour occurred in water masses of low salinity in Seden Strand.

The dinoflagellate Oxyrrhis marina Dujardin was

recorded in a plankton sample from Køge Bugt in the Sound.

A mass occurrence is mentioned as Phaeocystis sp. in the littoral zone at the bathing place Fanø. (Auth. summ.)

**4386.** Larsen, Knud. 1960-61. THE FISH POPULATION OF A PEAT PIT AS DETERMINED BY ROTENONE POISONING. Meddelelser Fra Danmarks Fiskeri-og Havundersøgelser, Vol. 3, Nos. 1-6, pp. 117-132.

A peat pit dug in 1940-41 with an expanse of water of 1 ha and an average depth of 1 metre was treated with the toxic substance rotenone in order to exterminate the fish there and make the pit suitable for being stocked with crayfish. The pit is occasionally connected with the Vaerebro river, from which fish must be supposed to have immigrated. Nothing is known about plantings out of fish apart from 20,000 elvers about 1945.

After the poisoning a total of 16,693 fish (482.2 kg) were collected, belonging to the 7 species pike, perch, tench, crucian carp, rudd, roach, and eel. According to number (82.2 per cent.) as well as weight (45.0 per cent.) roach was dominant in the population regardless of the fact that 25-50 per cent. of the small fry of roach escaped registration. According to number the sequence then was as follows: perch (9.1 per cent.), rudd (7.6 per cent.), pike (0.7 per cent.), tench (0.4 per cent.), eel (0.03 per cent.), and crucian carp (0.01 per cent.).

A comparison with other waters treated with rotenone (U.S.A., Sweden) shows that the fish population in the peat pit presumably is the largest one hitherto demonstrated in a stagnant water not rationally operated (1.67 fish per sq. m.). It is, however, as regards density, surpassed by a pure population of crucian carp with 2 fish per sq. m in the lake Søndersø Skovsø (North Sunen).

In sections about the various species of fishes their susceptibility to the toxic effect is mentioned, as well as other conditions of importance for the evaluation of the effectivity of the method for analyses of populations. Furthermore, the composition of the populations according to size and age and the size of the area which provided even distribution, has been at the disposal of each fish. This area in the various cases is as follows: pike 90 sq. m, perch 6.6 sp. m, tench 166.7 sq. m, crucian carp 10,000 sp. m, rudd 7.9 sp. m, roach 0.7 sq. m, eel 2,000 sq. m. For the total population 0.6 sq. m was available to each individual.

For angling practice the investigations showed that peat pits of the type discussed can be very productive, but that a regulation of the ratio of suitable species (pike, perch, eel) to unsuitable ones (tench, crucian carp, rudd, roach) is a necessary condition for an optimal utilization by the angler. Rotenone treatment followed by restocking with suitable species of fish or crayfish seems to be an excellent method in small waters, where the control of the unsuitable species has been neglected or has otherwise proved impracticable. (Auth. summ.)

**4387.** Eddy, Samuel, and Thaddeus Surber. 1960. NORTHERN FISHES. WITH SPECIAL REFERENCE TO THE UPPER MISSISSIPPI VALLEY. 2d Ed. (Originally published by the University of Minnesota Press.) xii+276 p. Illus. Charles T. Branford Company, Newton Centre 59, Mass.; Biological Abstracts, Vol. 36, No. 6, Abst. No. 16292. 1961.

A comprehensive survey treatment of the fishes of the Upper Mississippi Valley, of particular interest to ichthyologists, conservationists and sport fishermen. There are discussions of fishing techniques, the dynamics of and suggestions for improvement of lakes and streams, fishing laws, propagation of fishes, and the classification, origin and structure of fishes. The major portion of the book is devoted to descriptive, illustrated keys (with brief ecological notes) to the 27 families of fishes found in this area. Bibliography and index complete the text. (M.C.R.)

**4388.** Halver, John E., and Warren E. Shanks. 1960. NUTRITION OF SALMONOID FISHES. VIII. INDISPENSABLE AMINO ACIDS FOR SOCKEYE SALMON. Jour. Nutrition 72(3): 340-346; Biological Abstracts, Vol. 36, No. 6, Abst. No. 16719. 1961.

The indispensable amino acid requirements for sockeye salmon were determined by feeding small groups of fish held in aquariums specific diets made deficient by deleting one amino acid at a time from a basal ration which contained 17 crystalline amino acids as the protein component. After 6 weeks, each group was divided into 2 equal sublots, one continued as before and the other placed on the control diet. The latter showed prompt growth response. No growth was obtained when arginine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan or valine was deleted from the ration. Growth identical to that of the control groups was obtained when diets devoid of alanine aspartic acid, cystine, glutamic acid, proline, serine or tyrosine were fed. No evidence was obtained for appreciable biosynthesis of arginine. Hence sockeye salmon apparently require the same amino acids for growth as chinook salmon, the weanling rat and the pig. (Auth. abst.)

**4389.** Clark, Sam L., Moon Yong Chung, Lee Shine, and Margaret R. Clark. 1960. RESPONSES IN FREE SWIMMING FISHES TO ELECTRICAL STIMULATION OF THE CEREBELLUM. Amer. Jour. Anat. 106(2): 121-132; Biological Abstracts, Vol. 36, No. 6, Abst. No. 17329. 1961.

Electrical stimulation of the cerebellum of 44 fish of 3 species was carried out through implanted electrodes attached to light long wires while the fish were free to swim in a large tub. The effects produced were changes in posture and movement involving head, body and tail, eyes and fins. The movement from most areas was turning to the contralateral side, but from the anterior part of the midportion of the cerebellum the turning was primarily homolateral. Rebound reversal of the movement occurred from points near the mid-line. Reversal of the primary direction from a point was observed in many instances on slightly increasing the strength of stimulus as on pushing the electrode deeper into the

cerebellum. A few points were stimulated in other regions of the brain. (Auth. abst.)

**4390.** Grenier, F. 1960. A CONSTANT FLOW APPARATUS FOR TOXICITY EXPERIMENTS ON FISH. Jour. Water Pollution Control Fed. 32(10): 1117-1119; Biological Abstracts, Vol. 36, No. 12. Abst. No. 35880. 1961

The use of a Mariotte bottle is proposed as a means of maintaining a constant renewal of bio-assay water with uniform test effluent concentration. (I. G.)

**4391.** Needham, James G. 1959. CULTURE METHODS FOR INVERTEBRATE ANIMALS. (A COMPENDIUM PREPARED UNDER THE DIRECTION OF A COMMITTEE FROM SECTION F OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, PAUL S. GALTSOFF, FRANK E. LUTZ, PAUL L. WELCH, ASSISTED BY MANY SPECIALISTS WHOSE NAMES APPEAR IN CONNECTION WITH THEIR RESPECTIVE CONTRIBUTIONS TO THIS VOLUME.) xxxii + 590 p. Illus. Dover Publications: New York 14; Biological Abstracts, Vol. 36, No. 12, Abst. No. 35891. 1961.

This book, prepared as an aid to studies that require living animals in continuous supply, has a very important place in biological teaching and research, and in nearly every field of applied biology. The experiences and efforts of many researchers has been combined here in order to present these cultural methods. The topics include sections on: General methods of collecting, maintaining, and rearing marine invertebrates in the laboratory; Collecting and rearing terrestrial and freshwater invertebrates, and The Phyla Protozoa, Porifera, Coelenterata, Plathelminthes, Nemertea, Nemathelminthes, Trochelminthes, Bryozoa, Annilida, Arthropoda, Mollusca, Echinodermata, and Chordata. There are 186 contributors who prepared material in this volume.

**4392.** Hrbacek, J., and M. Hrbackova-Esslova. 1960. FISH STOCK AS A PROTECTIVE AGENT IN THE OCCURRENCE OF SLOW-DEVELOPING DWARF SPECIES AND STRAINS OF THE GENUS DAPHNIA. Internatl. Rev. ges. Hydrobiol. 45(3): 355-358; Biological Abstracts, Vol. 36, No. 12, Abst. No. 35926. 1961.

Species of Daphnia were obtained from ponds with various fish populations. Growth rate was highest in Daphnia clones from ponds with few fish, and it was lowest in those from ponds with large fish populations. It is thought that the larger fish stock, by destroying the larger and more rapidly growing Daphnia strains, protects the small slow-moving strains from the competition of more efficient clones. (C. C. D.)

**4393.** Beklemishev, C. W. 1960. BIOTOPE AND COMMUNITY IN MARINE PLANKTON. Internatl. Rev. ges. Hydrobiol. 45(2): 297-301; Biological Abstracts, Vol. 36, No. 12, Abst. No. 36177. 1961.

The biotopes of plankton communities are three dimensional, are movable with the currents, and they mix with other biotopes when water masses mix. In these respects they differ fundamentally from benthic communities. The boundaries of plankton communities are the boundaries of water masses, but where water masses mix there may be wide bands with mixed plankton communities. Often these bands contain a larger number of plankton species than either community alone. Along the front between two plankton communities large eddies often occur, which carry small unmixed portions of one community deep into the territory dominated by another community. In the front where mixing of the tropical Kuroshio and the boreal Oyashio waters occurs, the upper layers (to 24m) are dominated by tropical plankters and the deeper water by boreal plankters. Other examples are given from tropical, Antarctic, and California waters. (C. C. D.)

**4394.** Koblenz-Mishke, O. J. 1960. ON THE STUDY OF PRIMARY PRODUCTION IN THE SEA BY SOVIET SCIENTISTS. Internatl. Rev. ges. Hydrobiol. 45(3): 319-326; Biological Abstracts, Vol. 36, No. 12, Abst. No. 36184. 1961.

Soviet methods of study of primary production by the oxygen and $C^{14}$ techniques are described. Figures from Soviet and other sources are given showing the amount of primary production occurring in the oceans of the world. Greater attention is paid to the Pacific. Greatest production is in boreal neritic waters, where hundreds of mg C are produced per day per $m^3$. Least production is in tropical oceanic water, where only tenths of a mg C are produced per day per $m^3$. Degree of oxygen saturation in surface waters is shown to be a good indication of the rate of carbon fixation. (C. C. D.)

**4395.** Wurtz, Charles B., and Colton H. Bridges. 1960. A STUDY OF THE EFFECTS OF INCREASED TEMPERATURES ON BIOCHEMICAL OXYGEN DEMAND. Proc. Pennsylvania Acad. Sci. 34: 69-73; Biological Abstracts, Vol. 36, No. 12, Abst. No. 36222. 1961.

The BOD test was done on Schuylkill River water at experimental times and temperatures. One massive sample was divided into 16 parts. These were incubated 1, 2, 5 and 7 days at 20, 28, 36 and 38°C. This was repeated once a week for three weeks. Schuylkill River water was also subjected to the standard, 5-day, 20°C. BOD test before and after passage through the condensers of the Barbadoes Steam Generating plant of the Philadelphia Electric Company at Norristown, Pa. This was done once a week for three weeks. These tests support the conclusion that increased water temperatures up to at least 100°F do not depress the biological self-purification capacity of a stream, although rates are affected. (Auth. abst.)

**4396.** Crass, R. S. 1960. BIOLOGICAL NOTES ON THE ACCLIMATIZATION OF TROUT IN NATAL. S. African Jour. Sci. 56(6): 147-151; Biological Abstracts, Vol. 36, No. 12, Abst. No. 36224. 1961.

The introduction of brown and rainbow trout in Natal has added a new element to the fauna, but their presence has caused only slight disturbance to in-

digenous aquatic life. Differences between conditions in various types of water have produced great contrasts in characteristics of local trout populations. (Auth. abst.)

**4397.** Peters, Hans M. 1959. ON THE RELATIONSHIP BETWEEN EGG NUMBER AND EGG WEIGHT IN FISH. (UBER DIE BEZIEHUNGEN ZWISCHEN EIZAHL UND EIGEWICHT BEI FISCHEN.) Zeitschr. Naturforsch. 14b(8/9): 584-592; Biological Abstracts, Vol. 36, No. 12, Abst. No. 37202. 1961.

The number of eggs per clutch in Tilapia mossambica (Cichlidae, Teleostei) increases greatly with body weight, but the values are scattered within wide limits. On the other hand a very exact correlation is shown if one compares the weight of the clutches with the body weights. That means that the fish either produce relatively few large eggs or relatively many small eggs, in such a way that for every body weight there is a definite total clutch weight. The animal is ready to spawn when this relationship is reached. The clutch remains in this condition for only a short time. If no spawning takes place the eggs are resorbed and a new clutch is formed. After investigation of the developmental history one can propose that at the beginning of clutch formation there are individuals in the number of oocytes competent for yolk deposition; whether the clutch is composed of larger or smaller eggs appears to depend on the number of competent oocytes which were present. (Auth. abst.)

**4398.** Clavert, J., and J. P. Zahnd. 1960. HISTOLOGICAL MODIFICATIONS OF THE LIVER IN THE FEMALES OF SOME SPECIES OF TELEOSTS DURING VITELLOGENESIS WHICH OCCURS DURING THE GREAT INCREASE OF THE OVOCYTES. (MODIFICATIONS HISTOLOGIQUES DU FOIE DES FEMELLES DE QUELQUES ESPECES DE TELEOSTEENS AU COURS DE LA VITELLOGENESE DE GRAND ACCROISSEMENT DES OVOCYTES.) Compt. Rend. Assoc. Anat. 46(106): 171-175; Biological Abstracts, Vol. 36, No. 12, Abst. No. 37247. 1961.

During vitellogenesis, in Salmo, Esox, Perca, Betta, Trichogaster, Aequidens, Pterophyllum, Lebistes and Xyphophorus, the female hormone causes an increase of hepatic activity. (L. A.)

**4399.** Wunder, W. 1960. IMPLANTATION INTO THE MUSCULATURE AND BODY CAVITY OF FISHES OF FOREIGN BODIES MADE FROM PLASTICS AND OTHER MATERIALS. INVESTIGATIONS ON CARP. (EINPFLANZUNG VON FREMDKORPERN AUS KUNSTSTOFFEN UND ANDEREM IN DIE MUSKULATUR UND IN DIE LEIBESHOHLE VON FISCHEN. VERSUCHE AN KARPFEN (CYPRINUS CARPIO L.).) Internatl. Rev. Ges. Hydrobiol. 45(2): 283-296; Biological Abstracts, Vol. 36, No. 12, Abst. No. 37998. 1961.

Except where infection occurred, there were no specific reactions of the fish to the implanted threads or plates that could be attributed to their chemical nature. This is contrary to reports on the effects of certain foreign bodies in some strains of white mice, where ulcers and even cancers were formed. The author believes the conditions in the mice may have been initiated by the physical irritation of the foreign bodies, rather than by their chemical nature. (C. C. D.)

**4400.** Lecal, J. 1957. EXPERIMENTAL RESEARCH ON THE BLENNIDAE OF CASTIGLIONE. (RECHERCHES EXPERIMENTALES SUR LES BLENNIDES DE CASTIGLIONE.) Bull. Biol. France et Belgique 91(2): 115-156; Biological Abstracts, Vol. 36, No. 12, Abst. No. 39169. 1961.

Studies on effects of fasting, low temperatures, euryhalinity on morphology and growth of 2 spp. of Blennius.

**4401.** Riedl, Rupert. 1960. A KINEMETER FOR THE OBSERVATION OF DREDGES AT ANY DEPTH. (EIN KINEMETER ZUR BEOBACHTUNG VON DREDGEN IN BELIEBIGEN TIEFEN.) Internatl. Rev. Ges. Hydribiol. 45(1): 155-167; Biological Abstracts, Vol. 36, No. 7, Abst. No. 19252. 1961.

A kinemeter is described, designed for an automatically closing sled-type dredge. It is designed to register the distance the dredge is dragged, the position of the dredge, and the configuration of the bottom. The magnitude of sampling errors can be calculated from the indicated information. Under normal conditions the quantitative errors in the estimation of sampled surface and of volume of sediment passing through the net are so small they can be neglected. When dragged at slow speeds the stabilization of the apparatus is so good that any sampling errors are due to the unevenness of the bottom, and not to its consistency. (C. C. D.)

**4402.** Margalef, Ramon. 1960. IDEAS FOR A SYNTHETIC APPROACH TO THE ECOLOGY OF RUNNING WATERS. Internatl. Rev. Ges. Hydrobiol. 45(1): 133-153; Biological Abstracts, Vol. 36, No. 7, Abst. No. 19508. 1961.

Some problems of the biology of running waters are discussed in terms of general ecological principles. The structure of ecosystems, succession, and productivity are considered. A tentative classification of running water systems is given, based mainly on observations in northern Spain. (C. C. D.)

**4403.** Pop, V. 1959. CONTRIBUTION TO THE STUDY OF THE DORSAL EYES IN LAMPETRA (EUDONTOMYZON) DANFORDI REGAN (CYCLOSTOMATA, PETROMYZONES). (CONTRIBUTII LA STUDIUL OCHILOR DORSALI LA LAMPETRA (EUDONTOMYZON) DANFORDI REGAN (CYCLOSTOMATA, PETROMYZONES).) (Russian and French summ.) Stud. Cercetari Biol. 10(1): 143-153; Biological Abstracts, Vol. 36, No. 7, Abst. No. 20272. 1961.

As opposed to Petromyzon marinis and P. planeri in Lampetra danfordi the cephalic route does not reach the level of the dorsal eyes and the dorsal sac is lower. In the distal eye (pineal organ) and

the proximal eye (parapineal organ) the authors found that in larvae of 2.5 cm and up to 11-17 cm in length, the permanent communication was not due to the joining of the routes of the 2 organs at levels where they are in contact. In effect the retina of the pineal organ is continuous without interruption by the retina of the parapineal organ. In larvae the pellucida of the retina of the pineal organ has sensory cells in its apex in the form of a club-shaped mass which forms the preeminence in the cavity. In adults the sensory cells cannot be distinguished in the retina, and these cells are not longer present in the route of the parapineal organ, but when the anterior portion of the parapineal organ passes beyond the pineal organ then sensory cells appear in the route. The authors considered this proof that the parapineal organ is conserved in this species as well as the potentiality of its sensory function. Both organs are simple eyes and their function may have been modified in present day forms. (MDS)

**4404.** Engstrom, Kjell. 1960. CONE TYPES AND CONE ARRANGEMENT IN THE RETINA OF SOME CYPRINIDS. Acta Zool. (Stockholm) 41(3): 277-295; Biological Abstracts, Vol. 36, No. 7, Abst. No. 20596. 1961.

The retina of 13 species has been studied by means of transverse and tangential sections. In all the species the same fundamental types of cones were found: 2 types of single cones, unequal double cones and in many species triple cones. In most of the species the 3 first-mentioned types build up a regular pattern consisting of rows mainly following the direction of the radii of the eye. This pattern is most perfectly developed in the equator of the eye and has often more or less disappeared in the ventral and dorsal parts. It also varies within certain limits between the different species, but all the patterns can be traced back to a fundamental one, common to the whole family. (Auth. summ.)

**4405.** Saddler, James Bryan, and Laurence Marvin Ashley. 1960. COMPARATIVE HISTOLOGY OF THE PYLORIC CAECA OF CERTAIN TELEOST FISH. Walla Walla Coll. Publ. (Washington) 27. 1-23; Biological Abstracts, Vol. 36, No. 7, Abst. No. 20609. 1961.

The literature on the histology of the pyloric caeca of fishes is reviewed. The histology of the pyloric caeca of 1 species each of Salmonidae, Scorpaenidae, Hexagrammidae, Ophiodontidae, and Cottidae is described, with comparisons between the families. Densely compacted and densely granular layers were found to be evident only in the family Salmonidae. Caeca from all 5 families showed a columnar epithelium, tunica propria, muscularis mucosae, submucosa, muscularis circularis, myenteric plexus of Auerbach, muscularis longitudinalis, and a serosa. A heavy concentration of goblet cells was shown in Scorpaenidae, Ophiodontidae, and Cottidae. The columnar epithelium reached its greatest height in Salmonidae and Cottidae, and least height in Ophiodontidae. It showed basal granulation to a greater degree in Cottidae than in the other families. The muscularis reached its greatest width in Ophiodontidae and least width in Salmonidae, while the muscularis longitudinalis reached its greatest width in Ophiodontidae and least width in Salmonidae and Hexagrammidae. (From. auth. summ.)

**4406.** Abbott, Betty J. 1959. A PRELIMINARY REPORT ON AN OCCURRENCE OF CAMPOSTOMA ANOMALUM (RAFINESQUE) IN THE YADKIN RIVER DRAINAGE SYSTEM. Virginia Jour. Sci. 10(3): 177-180; Biological Abstracts, Vol. 36, No. 7, Abst. No. 22364. 1961.

A new record of the stoneroller minnow was taken in a collection from Johnson Creek of the Yadkin River drainage system in Carroll County, Virginia. It appears to be related to the New (upper Kanawha) River campostomid kanawhanum and shows some relationship to the Roanoke and James River campostomid virginianum. This record gives biological evidence to suspected stream capture in this area and lends credence to Evermann's (1916) record of Campostoma anomalum from the Lumbee (Lumber) River of Yadkin drainage in North Carolina. (Auth. abst.)

**4407.** Cridland, C. C. 1960. LABORATORY EXPERIMENTS ON THE GROWTH OF TILAPIA SPP. I. THE VALUE OF VARIOUS FOODS. Hydrobiologia 15(1/2): 135-160; Biological Abstracts, Vol. 36, No. 7, Abst. No. 22366. 1961.

The growth-rate and ultimate size of Tilapia is determined largely by the conditions in which they have grown. The relative value of several foods was tested by feeding them to T. esculenta fry. Best growth was obtained with a mixed diet, but certain whole organisms have good growth. Fish fed on oligochaete worms grew almost as well as fish fed on a more elaborate diet, and this diet will be used in future experiments. Fish fed entirely on beef and Tilapia muscle did not grow well whereas those fed on Mormyrus (an insectivorous fish) muscle developed normally. A diet of algae which is the normal food of T. esculenta did not give as good results as diets containing some animal protein. Bemax and maize meal gave poor results. Under identical conditions T. escultenta grew about 3 times as fast as T. variabilis. (K. E. M.)

**4408.** Gasowska, Matylda. 1960. GENUS COREGONUS L. DISCUSSED IN CONNECTION WITH A NEW SYSTEMATIC FEATURE THAT OF SHAPE AND PROPORTION OF OS MAXILLARE AND OS SUPRAMAXILLARE. (Polish and Russian summ.) Ann. Zool. 18(26): 471-512; Biological Abstracts, Vol. 36, No. 7, Abst. No. 22369. 1961.

A systematic division of the genus based on the shape of os maxillare and supramaxillare is proposed; this feature seems to have a higher systematic value than the number of gill rakers. (A. P.)

**4409.** Kuthalingam, M. D. K. 1959. A CONTRIBUTION TO THE LIFE HISTORIES AND FEEDING

HABITS OF HORSE-MACKERELS, MEGALASPIS CORDYLA (LINN.) AND CARANX MATE (CURV. AND VAL.) AND NOTES ON THE EFFECTS OF ABSENCE OF LIGHT ON THE DEVELOPMENT AND FEEDING HABITS OF LARVAE AND POST LARVAE OF MEGALASPIS CORDYLA. Jour. Madras Univ. 29B(2): 79-96; Biological Abstracts, Vol. 36, No. 7, Abst. No. 22374. 1961.

Eggs, larvae and juveniles of the 2 spp. are described in detail and the diet of the various stages compared to that of adults. Feeding begins at transformation of pro-larvae to post-larvae. Absence of light retarded hatching of M. cordyla eggs by 26 hrs. and resulted in disappearance of pigment in the embryo. (D. E. F.)

**4410.** Ivlev, V. S. 1960. ON THE UTILIZATION OF FOOD BY PLANKTOPHAGE FISHES. Bull. Math. Biophys. 22(4): 371-389; Biological Abstracts, Vol. 36, No. 8. 1961.

Making some plausible assumptions about the over-all mechanism of food catching and consumption by fishes and evaluating in the light of those assumptions some available experimental data, it is possible to calculate from those data the variation of several important factors with the concentration of food. The factors considered are: total rate of metabolism, total diurnal energy expenditure in the process of feeding, average number of hours per day during which the fish feeds, average length of path traveled by a fish per day, and the so-called "energetic coefficient of growth." A possible relation with the work of N. Rashevsky (Bull. Math. Biophysics, 20, 299-308, 1959) is discussed. (Auth. abst.)

**4411.** Sen, D. N., and U. N. Chatterji. 1960. A STUDY ON THE AQUATIC PLANT COMMUNITY AT GORAKHPUR IN RELATION TO THE PH OF THE MEDIUM. Proc. Natl. Acad. Sci. 30(3): 187-191; Biological Abstracts, Vol. 36, No. 8, Abst. No. 23133. 1961.

Observations were made in regard to the relation of water pH to an aquatic plant community consisting of Hydrilla verticillata, Vallisneria spiralis, Marsilea quadrifolia, Chara species, Spirogyra species and Ceratophyllum demersum. High pH values were recorded from the pond water at the time when the ponds were more or less dried up and the vegetation flourished well. This has been summarized for four ponds graphically to show the density of population of individual plants forming this aquatic plant community. The pH value was almost always above 7, thereby showing the plant community's preference towards alkalinity. The pH values were determined straight from pond water, and not from the soil samples forming the bed which supports this community. A considerable variation in the pH values has been observed by the authors. It appears that surrounding water exerts an appreciable influence on the formation of plant community in the pond. The correlation between the high pH values of water and the luxuriant vegetation has been discussed. (Auth. abst.)

**4412.** Butler, John L. 1960. DEVELOPMENT OF THE WEBERIAN APPARATUS OF A CATOSTOMID FISH. Proc. Iowa Acad. Sci. 67: 532-543; Biological Abstracts, Vol. 36, No. 8, Abst. No. 24462. 1961.

The apparatus in the adult Pantosteus plebius, the Rio Grande mountain sucker, is complex, particularly so in the modification of the anterior vertebrae. The Weberian ossicles are derived from components of the anterior 3 vertebrae and from independent connective tissue ossifications. Development is rapid, with the rudiments appearing when the fish are approximately 9 mm long, and the ossicles reach their mature shape at about the 12 mm stage. (Auth. abst.)

**4413.** Comfort, A., and F. Doljanski. 1958. THE RELATION OF SIZE AND AGE TO RATE OF TAIL REGENERATION IN LEBISTES RETICULATUS. Gerontologia 2(5): 266-283; Biological Abstracts, Vol. 36, No. 8, Abst. No. 24498. 1961.

Tailwebs of female guppies were cut off transversely, and the rate of regeneration determined at ages from birth to 3 years: a) in fish growing under normal aquarium conditions; b) in fish whose growth was stopped by food restriction; c) in retarded fish during resumed growth. The percentage of a defect restored after 20 days in normally-growing fish falls with age and size. The curve of its decline is a mirror-image of the growth in body length. In starved fish which are not growing, the regeneration rate is about the same as in full-sized littermates: in starved fish which have resumed growth, it is much faster. Regeneration rate in females is determined chiefly by the status of general body-growth. As body-size approaches its asymptote for a given set of conditions, regeneration rate falls to a basal level. When growth is resumed, it rises again. Old, previously starved fish which fail to grow when transferred to better conditions may still respond by a rise in regeneration-rate. The basal level of regeneration is higher in males than females, and in wild-type compared with fancy-tailed males. The histology of the regenerative process in Lebistes tail-web is described and illustrated. (Auth. summ.)

**4414.** Hood, D. W., T. Ward Duke, and B. Stevenson. 1960. MEASUREMENT OF TOXICITY OF ORGANIC WASTES OF MARINE ORGANISMS. Jour. Water Pollution Control Fed. 32(9): 982-993; Biological Abstracts, Vol. 36, No. 11, Abst. No. 33113. 1961.

The importance of phytoplankton as basic food supply in marine ecosystems prompted a study of the effect of organic industrial effluents on the metabolism of crustacea and phytoplankton for comparison with acute toxicity to marine fish and grass shrimp. Existence of sublethal stress was noted by measuring inhibition of photosynthesis of various marine phytoplankton, as well as differential oxygen utilization by brine shrimp. Further studies such as specific enzyme inhibitor effects are suggested. Forty-seven references are appended. (I. G.)

**4415.** Beverton, R. J. H., J. A. Gulland, and A. R. Margetts. 1959. WHITING TAGGING: HOW THE TAG RETURN RATE IS AFFECTED BY THE CONDITION OF FISH WHEN TAGGED. Jour. Conseil Perm. Internatl. Explor. Mer 25(1):53-57; Biological Abstracts, Vol. 36, No. 11, Abst. No. 33136. 1961.

A technique is described of classifying the condition of whiting when being tagged. The influence of condition on the rate of recapture is shown from an experiment in which 6,200 whiting were tagged in the Irish Sea, November-December 1957, and from which 869 (14.1%) were recaptured within 7 months of liberation. The fish were graded on tagging according to whether they floated or swam down in the marking tanks, whether the floaters were lively or sluggish, and according to the extent of scale damage. The extent to which fish were blown or could swim did not greatly affect returns, but the extent of scale damage certainly did. Returns from fish scales in good condition were three times those from fish with extensively damaged scales. The highest percentage of returns (28%) came from the category of fish which swam down in the tanks and had scales in good condition. The implications of these results to questions of the estimation of the true fishing rate and of the mortality due to tagging are discussed. It is concluded that where an objective system of condition classification can be devised it may materially enhance the value of the information obtained from the tagging experiment. (Auth. abst.)

**4416.** Wise, John P. 1958. THE WORLD'S SOUTHERNMOST INDIGENOUS COD. Jour. Conseil Perm. Internatl. Explor. Mer 23(2): 208-212; Biological Abstracts, Vol. 36, No. 11, Abst. No. 33169. 1961.

It is consistent with the facts gathered from tagging experiments to consider the cod ranging from Nantucket Shoals to North Carolina as a separate group, at least partially independent of the southern New England cod with which they mingle in the warm months. (Auth. abst.)

**4417.** Wood, E. M. 1960. DEFINITIVE DIAGNOSIS OF FISH MORTALITIES. Water Pollution Control Fed. 32(9): 994-999; Biological Abstracts, Vol. 36, No. 11, Abst. No. 33170. 1961.

Two major factors in fish mortality diagnosis are characterization of the environment and examination of the affected population. It is felt that sufficient knowledge of fish pathology is now available for its use as a tool in identifying causes of mortality. Where certain compounds are suspected, fish may be subjected to their influence to determine resultant pathology for comparison with the observed mortality. Examples are presented of tissue changes caused by hydrogen sulfide, heavy metals, bacterial and protozoan infections. Collection and adequate preservation of representative specimens are emphasized. (I.G.)

**4418.** Sulya, L. L., B. E. Box, and Gordon Gunter. 1960. DISTRIBUTION OF SOME BLOOD CONSTITUENTS IN FISHES FROM THE GULF OF MEXICO. Amer. Jour. Physiol. 199(6): 1177-1180; Biological Abstracts, Vol. 36, No. 11, Abst. No. 33581. 1961.

Several constituents of the plasma of families and species of fishes from Gulf Coast marine waters were studied. Values for sodium, potassium and chloride were found to be higher in elasmobranchs than in teleosts, in agreement with previous work. High salinity teleosts and euryhaline teleosts had a closely similar total electrolyte content, which was somewhat higher than the low salinity teleosts. The value for hemoglobin in several species is recorded for the first time. Highest values were found in the sharks. Cholesterol in primitive species, the sharks and gars, is comparable to the values observed in higher vertebrates but in the higher fishes it is much higher, achieving a level of 1440 gm% in the ten-pounder. The percentage of cholesterol esters is relatively low in the primitive species, but in some of the more highly developed fishes it makes up virtually the entire total cholesterol component. The analogy between the abnormalities observed in nephrotic sera and the apparent normal distribution of plasma proteins and lipids in many species of fishes is discussed. (Auth. abst.)

**4419.** Wittenberg, Jonathan B. 1961. THE SECRETION OF OXYGEN INTO THE SWIM-BLADDER OF FISH. I. THE TRANSPORT OF MOLECULAR OXYGEN. Jour. Gen. Physiol. 44(3): 521-526; Biological Abstracts, Vol. 36, No. 11, Abst. No. 33652. 1961.

Fish were maintained in sea water equilibrated with a gas mixture containing a non-equilibrium mixture of the three molecular species of oxygen, $O^{18}$-$O^{18}$ (mass 36), $O^{18}$-$O^{16}$ (mass 34), and $O^{16}$-$O^{16}$ (mass 32). Analyses in the mass spectrometer, of the gases secreted into the swim-bladder showed that no change in the relative abundance of these three molecular species had occurred during the secretory process and that therefore no exchange of atoms between oxygen molecules had occurred. Scission of the oxygen-oxygen bond probably does not occur during the transport process. It is concluded that the active transport of oxygen into the swim-bladder by the gas gland is a transport of molecular oxygen. (Auth. abst.)

**4420.** Wittenberg, Jonathan B., and Beatrice A. Wittenberg. 1961. THE SECRETION OF OXYGEN INTO THE SWIM-BLADDER OF FISH. II. THE SIMULTANEOUS TRANSPORT OF CARBON MONOXIDE AND OXYGEN. Jour. Gen. Physiol. 44(3): 527-542; Biological Abstracts, Vol. 36, No. 11, Abst. No. 33653. 1961.

Toadfish, Opsanus tau, L., were maintained in sea water equilibrated with gas mixtures containing a fixed proportion of oxygen and varying proportions of carbon monoxide. The swim-bladder was emptied by puncture, and, after an interval of 24 or 48 hours, the newly secreted gases were withdrawn and analyzed. Both carbon monoxide and

oxygen are accumulated in the swim-bladder at tensions greater than ambient. The ratio of concentrations, carbon monoxide (secreted): carbon monoxide (administered) bears a constant relation to the ratio, oxygen (secreted): oxygen (administered). The value of the partition coefficient describing this relation is (a = 5.44). The two gases are considered to complete for a common intracellular carrier mediating their active transport. The suggestion is advanced that the intracellular oxygen carrier is a hemoglobin. Comparison of the proportions of carboxy-and oxyhemoglobin in the blood with the composition of the secreted gas proves that the secreted gases are not evolved directly from combination with blood hemoglobin. The suggestion is advanced that cellular oxygen secretion occurs in the rete mirabile: the rete may build up large oxygen tensions in the gas gland capillaries. It is suggested that the gas gland acts as a value impeding back diffusion of gases from the swim-bladder. (Auth. abst.)

**4421.** Yamagami, Kenjiro. 1960. PHOSPHORUS METABOLISM IN FISH EGGS. II. TRANSFER OF SOME PHOSPHORUS COMPOUNDS FROM EGG YOLK INTO EMBRYONIC TISSUES IN SALMO IRIDEUS DURING DEVELOPMENT. Sci. Papers Coll. Gen. Educ. Univ. Tokyo 10(2): 325-336; Biological Abstracts, Vol. 36, No. 11, Abst. No. 34359. 1961.

Changes in the distribution of some phosphorus compounds in the whole egg, isolated embryo and in egg yolk of the rainbow trout, Salmo irideus were examined during the course of early development. Amounts of PP in the whole egg and alevin caused an abrupt decrease as development went on, with the corresponding increase in Pt (especially in Pi) and TNA-P (DNA-P + RNA-P). The LP content remained almost unchanged until several days after hatching, and thereafter it was reduced rather exceedingly until the yolk-free fry stage. Amounts of all phosphorus compounds except phosphoprotein in the isolated embryo underwent a remarkable increase in hyperbolic fashion during the course of growth and differentiation. The PP content in the embryo showed a slight increase during these periods of time. Contents of all phosphorus compounds per mg dry weight of embryonic tissues exhibited an augmentation from the 3rd to 15th or 18th day, and thereafter those of Po, LP and TNA-P remained unchanged, whereas those of Pi continued to increase after hatching. Although the amounts per yolk mass of most phosphorus compounds were reduced exclusively in the process of development, only the Pi content per yolk mass showed a marked increase until just after hatching. (Auth. abst.)

**4422.** Kendall, James I. 1961. IN VIVO STAINING OF CALCIFIED TISSUES OF SHARKS. Turtox News 39(2): 77; Biological Abstracts, Vol. 36, No. 11, Abst. No. 34419. 1961.

Small specimens of nurse shark (Ginglymostoma cirratum) are force-fed a mixture of food and dye (alizarine Red S) to determine calcium deposition over a known period. Food and dye are homogenized in blender and frozen into cubes, each containing 0.25 g of dye. After thawing, the mixture is forced into the stomach with a baster and tubing. A pink color develops in calcified areas. (R. W. D.)

**4423.** Mason, Charles T., Jr., and Richard H. Hevly. 1961. ADDITIONS TO THE AQUATIC FLORA OF ARIZONA. Madrono 16(1): 32; Biological Abstracts, Vol. 36, No. 11, Abst. No. 34918. 1961.

The following four species of aquatic plants are reported as additions to the known flora of Arizona: Elatine californica Gray; Limosella aquatica Sesse and Mocino; Potamogeton richardsonii (Benn.) Rydb; Typha angustifolia L. (C. T. M.)

**4424.** Westlake, D. F. 1960. WATER WEED AND WATER MANAGEMENT. J. Instn publ. Hlth Engrs, 59, 148-164; Water Pollution Abstracts, Vol. 34, No. 4, Abst. No. 618. 1961.

In a paper presented at a meeting of the Institution of Public Health Engineers in London in February, 1960, the author dealt with basic essentials of plant physiology, and then went on to discuss the importance of water weeds in connection with river pollution, water supply, land drainage, fisheries, and sewage disposal. From studies carried out on Lake Mendota, Wis., and on Dubbs reservoir in England, and on a heavily polluted stream (Maple Lodge sewage works effluent channel) and an unpolluted stream (the river Ivel), it was found that the effects of water weeds are usually much greater in rivers than in lakes. The effect of water weeds on conditions in a polluted stream especially chemical effects such as that on the oxygen balance, and physical effects (including those on the level and velocity of rivers and the occurrence of silting and flooding) were then discussed in detail, as the physical effects have an indirect influence on pollution and are important where drainage is concerned. The effect of water weeds on fisheries and sewage disposal were dealt with briefly, and methods of control of the weeds were outlined. A list of 29 references was included.

In a discussion following the paper, more attention was paid to the growth of water weeds in rivers and streams ( including the effect of sewage effluents on their growth), and their effect on the condition of a polluted stream. (Contract. Rec., 1960, 71, No. 29, 10-11; No. 30, 27, 29, and 35; and No. 32, 19.)

**4425.** Albrecht, M. L., and F. W. Tesch. 1959. FISHERY-BIOLOGICAL INVESTIGATIONS IN FLOWING WATERS. II. THE ILM. Z. Fisch, 8 (N. F.), No. 1/3, 116-164; Water Pollution Abstracts, Vol. 34, No. 4, Abst. No. 619. 1961.

The authors describe a biological investigation of the Ilm, a tributary of the Saale, 124 km in length. After a brief description of the geology of the region, the chemistry and condition of the river water are discussed. The river receives sewage from a number of towns; the effects disappear in 1-2 km except in the case of Weimar, pollution from

which is still evident 10 km downstream. Qualitative and quantitative investigations of fauna showed considerable variations from year to year. A detailed study was made of the fish population. One conclusion drawn is that in judging trout waters more attention should be paid to the morphology, topography, and flow of streams; rivers with stretches of varying condition contain larger and better fish than straight sections with even flow.

**4426.** Liebmann, H. 1960. THE INFLUENCE OF SEWAGES ON FISHERIES. Pap. 7th tech. Meeting, int. Un. Conserv. Nat. nat. Res. 1958, 4, 236-241; Water Pollution Abstracts, Vol. 34, No. 4, Abst. No. 749. 1961.

The author reviews briefly the harmful effects that waste waters can have on fish and fisheries, including direct toxic effects, depletion of dissolved oxygen, shift of the biological balance in the receiving stream and the production of tastes in fish flesh.

**4427.** Sylvester, R. O., and R. H. Bogan. 1960. PESTICIDES AND LAKE REHABILITATION. Publ. Wks., N. Y., 91, No. 7, 97-98 and 182...188; Water Pollution Abstracts, Vol. 34, No. 4, Abst. No. 759. 1961.

Approximately 30 materials representing the major classes and types of commercial pesticides in present-day use, including captane, chlordane, DDT, dieldrin, malathion, parathion and TEPP, were studied to investigate the effect of biological oxidation on these substances. With few exceptions the pesticides were found to be highly resistant to biochemical oxidation; where significant oxidation was observed, however, it appeared to be centred mainly in acyclic side chains and groupings. Halogen substitution and the presence of heavy metals either blocked or inhibited oxidation. Of the materials studied only malathion appeared subject to rapid biochemical oxidation. Many substances were toxic or inhibitory at concentrations as low as 50 mg per litre. A study being carried out by the University of Seattle in an effort to improve lake Green, Wash., and its environment for recreational purposes is outlined.

**4428.** Knopp, H. 1959. THE ROLE OF PHYTOPLANKTON IN OXYGENATION CONDITIONS IN RIVERS. Dtsch. Gewasserkundl. Mitt., 3, 139-147; Water Pollution Abstracts, Vol. 34, No. 5, Abst. No. 797. 1961.

Using the light-and-dark flask method, measurements were made in the Main and the Rhine of the aeration efficiency of phytoplankton. From the results it appears that the amount of plankton flowing through a cross-section of the Rhine at Koblenz has an oxygen production of about 165-200 tonnes per day, which would be equivalent to the 5-day B. O. D. of a population of 15-18.5 mil. Biochemical as well as physical oxygenation must therefore be taken into account. Long-term series of measurements of the oxygen production potential of phytoplankton in Rhine water show seasonal variations. Only between November and March is there no considerable oxygen production by plankton. The author then discusses, with examples, the effects of various factors (discharge of sewage and waste waters, alterations in cross-section or average depth, condition of banks) on the conditions of oxygen production.

**4429.** Krause, H. R. 1960. THE DECOMPOSITION OF ORGANIC PHOSPHORUS COMPONENTS FROM DEAD FRESHWATER ZOOPLANKTON. Naturwissenschaften, 47, 401; Water Pollution Abstracts, Vol. 34, No. 5, Abst. No. 821. 1961.

Experiments are described which were made to determine the rate at which organic phosphorus is eliminated from dead animal plankton in normal conditions of decomposition. The rate of reduction of the different fractions of organic phosphorus in suspensions of dead Cyclops and Mixodiaptomus was measured under aerobic and anaerobic conditions. The results show that the phosphorus in the organism decreases very rapidly after death, more than 70 per cent of the original total phosphorus entering the water after one day's decomposition. The large quantities and rapid removal of acid-soluble phosphorus and phosphorus combined with nucleic acids appear to be of special limnological importance.

**4430.** Silvey, J. K. G. 1960. PHYSICAL, CHEMICAL AND BIOLOGIC EFFECTS OF HEXADECANOL OF LAKE HEFNER, 1958. J. Amer. Wat. Wks Ass., 52, 791-802; Water Pollution Abstracts, Vol. 34, No. 5, Abst. No. 840. 1961.

Investigations carried out on lake Hefner, Okla., before and after treatment (in July 1958) with hexadecanol to control evaporation, showed that the hexadecanol had no deleterious effect on the chemical quality of the water (the only physico-chemical change being a lowering of the surface of the thermocline, which is regarded as unimportant), and was not utilized by plankton, but caused an increase in the growth of certain sedges which serve as nutrients for taste- and odour-producing actinomycetes, and in the bacterial population, which, although the species concerned were not of hygienic significance, would increase the chlorine demand of water treated at the Lake Hefner filtration plant; this plant reduced the bacterial count of the water from 10 mil. to 1000 per ml. It is considered that further bacteriological studies are necessary before the use of hexadecanol in water supply reservoirs can be approved. The breakdown and utilization of hexadecanol by bacteria appears to be of greater economic, rather than hygienic, significance. After the water temperature reaches 26°C, the amount of hexadecanol consumed by bacteria in a given area, which in the first 3 weeks of application is equal to the quantity required to cover that area, continues to increase in a geometric ratio. Since the bacterial population decreases rapidly when the hexadecanol is removed, reaching a low concentration in about 3 weeks, it is suggested that (unless bactericides can be found which will reduce the bacterial population effectively in the presence of hexadecanol) the hexadecanol should be added for a period of 6 weeks, followed by a lapse of 3 weeks before the next application.

**4431.** Wachek, F. 1959. THE PROBLEM OF THE PERMISSIBLE POLLUTION LOAD ON FLOWING WATERS. Z. Fisch, 8 (N.F.), No. 1/3, 87-104; Water Pollution Abstracts, Vol. 34, No. 5, Abst. No. 928. 1961

The author describes an experimental plant developed by him for determining the effect of sewage and trade waste waters on fish in flowing water. The plant comprises two tanks, each divided by a central wall, in which the water can be moved at desired rates by two motor-driven screws. The results of some experiments are described and the possibility of carrying out experiments at treatment works with transportable tanks is discussed.

**4432.** Anonymous. 1960. NEW LIFE FOR POLLUTED SWEDISH LAKES. Wat. Waste Treatm. J., 8, 65; Water Pollution Abstracts, Vol. 34, No. 5, Abst. No. 941. 1961.

Conditions in lake Langsjon, Sweden, which was seriously polluted in summer 1959, were considerably improved by means of compressed air introduced into the water through a perforated plastic hose laid along the bottom of the lake. In less than 3 weeks the dissolved oxygen content of the water increased from zero to 57 per cent, new plant life appeared, and the original temperature difference of 12°C between surface and bottom water disappeared owing to the turbulence induced by the compressed air. The water becomes oxygenated not by the compressed air itself, but by the waves created by the pumping action of the air as it forces its way to the surface. The compressed air method is to be tested at other Swedish lakes, beginning soon at the town of Torshalla and at Munksjon. Before adopting the compressed air method, the lake water must be examined, particularly the bottom stagnant water, to detect any hydrogen sulphide which might create an odour nuisance.

**4433.** Cervenka, R., M. Stepanek, and M. Votavova. 1959. LIMNOLOGICAL STUDY OF THE RESERVOIR SEDLICE NEAR ZELIV. VII. A CONTRIBUTION TO THE TECHNIQUE OF SELECTING NEW ALGICIDE COMPOUNDS. Sci. Pap. Inst. chem. Technol., Prague, Fac. Technol. Fuel Wat., 3, Pt. 1, 247-290 (English summary); Water Pollution Abstracts, Vol. 34, No. 5, Abst. No. 943. 1961.

Climatic conditions in Czechoslovakia are favourable for the growth of algal blooms in reservoirs, and in the Sedlice reservoir, the deterioration of water caused by algal blooms is often more significant than the direct pollution due to domestic and trade waste waters. Studies were therefore carried out to determine the best method for controlling the phytoplankton, including tests with various chemical substances to determine their effects on algae and on aquatic flora and fauna, particular attention being given to preparations containing silver and/or copper ions and those containing sodium pentachlorophenate. On the basis of the results obtained, which are presented in tables and graphs, the use of compound CP 310 (containing 300 µg of sodium pentachlorophenate in 1 litre) was recommended, since it was a very effective algicide and was harmless to all invertebrates and fish. In considering the application of algicides to large surface areas, it was concluded that the dose required cannot be calculated on the basis of the volume of the whole reservoir; relatively high doses must be used in the trophogenic layer, their effects being of only short duration, and subsequent dispersion into the whole reservoir soon reducing the apparently high doses. Further studies are considered necessary to discover more efficient and more economical algicides.

**4434.** Lebedeva, G. B. 1959. THE ACCUMULATION OF CERIUM-144 BY YEAR-OLD CARP AND WATER THYME. Med. Radiol., 4, No. 4, 73-77; Water Pollution Abstracts, Vol. 34, No. 5, Abst. No. 949. 1961.

Experiments have shown that the accumulation of cerium-144 in the tissues of fish is directly related to the specific activity of the water. Cerium-144 was taken up much more rapidly by water thyme than by young carp.

**4435.** Goodnight, C. J., and L. S. Whitley. 1960. OLIGOCHAETES AS INDICATORS OF POLLUTION. Wat. & Sewage Wks, 107, 311; Water Pollution Abstracts, Vol. 34, No. 6, Abst. No. 1018. 1961.

Investigations are at present being carried out in Indiana on the possibility of using oligochaetes as indicators of pollution in streams and rivers. It was observed that many thousands of oligochaetes (small, aquatic, annelid worms, of the family Tubificidae) occurred in the polluted areas of streams, often making the bottom appear a dull red colour. Studies are in progress on a drainage ditch southeast of Lafayette, Ind., to investigate the physical, chemical, and bacteriological characteristics (including determinations of dissolved oxygen, free carbon dioxide, total hardness, calcium hardness, pH value, and B.O.D., and coliform analyses) of water samples from 7 stations, and of samples of bottom fauna from the same stations, which are stored after classification. Conclusive results have not yet been obtained, but it is thought that oligochaetes may well be used as indicators of pollution. This study is being supplemented by others on other streams throughout Indiana, and the effects of various pollutants on the growth and reproduction of tubificid worms are also being investigated.

**4436.** Oliveira, L. P. H., R. Nascimento, L. Krau, and A. Miranda. 1959. HYDROBIOLOGICAL OBSERVATION ON FISH MORTALITY IN THE LAGOON OF CAMORIM. Mem. Inst. Oswaldo Cruz, 57, 115-126; Water Pollution Abstracts, Vol. 34, No. 6, Abst. No. 1129. 1961.

During February every year since 1956, there has been large-scale death of fish in the lagoon at Camorim, Brazil. From observations of conditions there it is thought that excess sea water entering the lagoon at this period causes excessive growth of surface plankton, and when these die the action of anaerobic bacteria results in production of hydrogen

sulphide which is the direct cause of the fish mortality. It is suggested that the flow of sea water should be regulated more carefully.

**4437.** Isom, B.G. 1960. TOXICITY OF ELEMENTAL PHOSPHORUS. J. Wat. Pollut. Contr. Fed., 32, 1312-1316; Water Pollution Abstracts, Vol. 34, No. 6, Abst. No. 1138. 1961.

Experiments have been carried out to determine whether elemental white phosphorus is toxic to fish in concentrations as low as its solubility or if the toxicity is due to colloidal $P_4$ or its oxidation products only. When a saturated solution of $P_4$ was filtered through a membrane filter, the filtrate was not toxic to bluegill (Lepomis macrochirus), but when the material retained by the filter was added to the water all the fish died within 24 hours, indicating that colloidal $P_4$ is the active toxicant. Analysis of stock solutions showed that they contained $P_4$ in amounts approximately equal to its solubility at 15°C. It is calculated that the $TL_m$ of colloidal $P_4$ is not greater than 0.105 mg $P_4$ per litre at 48 hours, nor less than 0.025 mg per litre at 163 hours.

**********

## AUTHOR INDEX

Abbott, Betty J.
A preliminary report on an occurrence of Campostoma anomalum (Rafinesque) in the Yadkin River drainage system. 4406
Albrecht, M. L., and F. W. Tesch.
Fishery-biological investigations in flowing waters. II. The Ilm. 4425
Alexander, Harold E.
Stream values, recreational use and preservation in the Southeast. 4287
Ali, M. A., P. Coper, and W. R. Stevenson.
Correlation of morphological and intra-ocular measurements in the Atlantic salmon, Salmo salar, yearling. 4379
Ali, M. A., W. R. Stevenson, and Judith S. Press.
Histophysiological studies on the juvenile Atlantic salmon, Salmo salar, retina. I. Rates of light - and dark - adaptation. 4282
Allison, Leonard N.
The fate of kidney disease among hatchery brook trout stocked in natural waters. 4281
Anderson, D. V.
A note on the morphology of the basins of the Great Lakes. 4307
Andrew, F. J., and G. H. Geen.
Sockeye and pink salmon production in relation to proposed dams in the Fraser River system. 4360
Anonymous.
Milfoil invades Chesapeake. 4320
New life for polluted Swedish lakes. 4432
Armitage, Kenneth B., and Jerry C. Tash.
A seasonal survey of the vertical movements of some zooplankters in Leavenworth County State Lake, Kansas. 4245
Ashley, Laurence Marvin, and James Bryan Saddler.
Comparative histology of the pyloric caeca of certain teleost fish. 4405

Bailey, Reeve M., and Robert A. Kuehne.
Stream capture and the distribution of the percid fish Etheostoma sagitta, with geologic and taxonomic considerations. 4267
Baldwin, Ruth E., Dorothy H. Strong, and James H. Torrie.
Flavor and aroma of fish taken from four fresh-water sources. 4335
Baslow, Morris H., and Ross F. Nigrelli.
Muscle acetylcholinesterase levels as an index of general activity in fishes. 4280
Baxter, John L.
A study of the yellowtail, Seriola dorsalis (Gill). 4326
Beardon, Charles M.
List of marine fishes recorded from South Carolina. 4277
Beaulieu, G., and E. Magnin.
Movements of tagged sturgeons in the Saint Lawrence River. (Deplacements des esturgeons (Acipenser fulvescens et A. oxyrhynchus)du fleuve Saint-Laurent d'apres les donnees du marquage.) 4363
Beeton, Alfred M.
Environmental changes in Lake Erie. 4331
Beklemishev, C. W.
Biotope and community in marine plankton. 4393
Benson, Norman G., John R. Greeley, Melvin I. Huish and Jerome H. Kuehn.
Status of management of natural lakes. 4338
Berst, A. H., and H. R. McCrimmon.
An analysis of sixty-five years of fishing in a trout pond unit. 4262
Bevan, Donald E.
Variability in aerial counts of spawning salmon. 4312
Beverton, R. J. H., J. A. Gulland, and A. R. Margetts.
Whiting tagging: how the tag return rate is affected by the condition of fish when tagged. 4415
Blahm, T. H.
Effect of tricaine methanesulfonate on oxygen consumption of juvenile sockeye salmon. 4340
Boetius, Jan.
Lethal action of mercuric chloride and phenylmercuric acetate on fishes. 4382
Bogan, R. H., and R. O. Sylvester.
Pesticides and lake rehabilitation. 4427
Bovbjerg, Richard V., Philip T. Clampitt, and Richard V. Bovbjerg.
An ecological reconnaissance of the bottom fauna, Millers Bay, Lake West Okoboji. 4370
Box, B. E., L. L. Sulya, and Gordon Gunter.
Plasma proteins in the blood of fishes from the Gulf of Mexico. 4374
Distribution of some blood constituents in fishes from the Gulf of Mexico. 4418
Brady, Lee, and Andrew Hulsey.
Propagation of buffalo fishes. 4290
Braem, Robert A.
A back-pack shocker for collecting lamprey ammocoetes. 4279
Bridges, Colton H., and Charles B. Wurtz.
A study of the effects of increased temperatures on biochemical oxygen demand. 4395
Buhler, D. R., W. T. Yasutake, and W. E. Shanks.
Chemotherapy of hexamitiasis in fish. 4237
Buss, Keen, and Dixon Waite.
Research units for egg incubation and fingerling rearing in fish hatcheries and laboratories. 4278
Butler, John L.
Development of the Weberian apparatus of a catostomid fish. 4412

Caldwell, David K.
Populations of the butterfish, Poronotus triacanthus (Peck) with systematic comments. 4298
Carlander, Kenneth D.
Variations on rereading walleye scales. 4343
Carlander, Kenneth D., and Richard R. Whitney.
Age and growth of walleyes in Clear Lake, Iowa, 1935-1957. 4328

Carpelan, Lars H.
Salinity tolerances of some fishes of a southern California coastal lagoon. 4276
Cervenka, R., M. Stepanek, and M. Votavova.
Limnological study of the reservoir Sedlice near Zeliv. VII. A contribution to the technique of selecting new algicide compounds. 4433
Chapman, D. G., and D. S. Robson.
Catch curves and mortality rates. 4336
Chatterji, U. N., and D. N. Sen.
A study on the aquatic plant community at Gorakhpur in relation to the pH of the medium. 4411
Christensen, Jørgen Møller.
The stock of soles Solea solea and the sole fishery on the Danish North Sea coast. 4380
Chung, Moon Yong, Sam L. Clark, Lee Shine, and Margaret R. Clark.
Responses in free swimming fishes to electrical stimulation of the cerebellum. 4389
Chung-Wai Ho, F., and W. E. Vanstone.
Plasma proteins of coho salmon, Oncorhynchus kisutch, as separated by zone electrophoresis. 4314
Clampitt, Philip T., Elizabeth L. Waffle, and Richard V. Bovbjerg.
An ecological reconnaissance of the bottom fauna, Millers Bay, Lake West Okoboji. 4370
Clark, Margaret R., Sam L. Clark, Moon Yong Chung, and Lee Shine.
Responses in free swimming fishes to electrical stimulation of the cerebellum. 4389
Clark, Sam L., Moon Yong Chung, Lee Shine, and Margaret R. Clark.
Responses in free swimming fishes to electrical stimulation of the cerebellum. 4389
Clavert, J., and J. P. Zahnd.
Histological modifications of the liver in the females of some species of teleosts during vitellogenesis which occurs during the great increase of the ovocytes. (Modifications histologiques du foie des femelles de quelques especes de teleosteens au cours de la vitellogenese de grand accroissement des ovocytes.) 4398
Cohen, Daniel M.
The scientific name of the common cod. 4377
Colebrook, J. M.
Plankton and water movements in Windermere. 4275
Comfort, A., and F. Doljanski.
The relation of size and age to rate of tail regeneration in Lebistes reticulatus. 4413
Coper, P., M. A. Ali, and W. R. Stevenson.
Correlation of morphological and intraocular measurements in the Atlantic salmon, Salmo salar, yearling, 4379
Cordone, Almo J., and Don W. Kelley.
The influences of inorganic sediment on the aquatic life of streams. 4351
Courtenay, Walter R., Jr.
Western Atlantic fishes of the genus Haemulon (Pomadasyidae): Systematic status and juvenile pigmentation. 4274
Crass, R. S.
Biological notes on the acclimatization of trout in Natal. 4396
Cridland, C. C.
Laboratory experiments on the growth of Tilapia spp. I. The value of various foods. 4407

Dannevig, Alf.
Government hatchery at Flødevigen, Report, 1952-56. (Statens utklekningsanstalt ved Flødevigen, Beretning 1952-56.) 4361
Dees, Lola T.
A list of the fishery bulletins of the United States Fish and Wildlife Service. 4294
United States Fish and Wildlife Service publications in limnology, 1940-1960. 4295
List of Special Scientific Report (Nos. 1-67) and Special Scientific Report--Fisheries (Nos. 1-357). United States Fish and Wildlife Service papers on physical and chemical oceanography. 4297
A list of circulars of the United States Fish and Wildlife Service. 4298
Doljanski, F., and A. Comfort.
The relation of size and age to rate of tail regeneration in Lebistes reticulatus. 4413
Donaldson, Lauren R., and Deb Menasveta.
Selective breeding of chinook salmon. 4332
Dovel, William
Larval development of the oyster toadfish, Opsanus tau. 4354
Dragovich. Alexander.
Relative abundance of plankton off Naples, Florida, and associated hydrographic data, 1956-57. 4323
Dragovich, Alexander, John H. Finucane, and Billie Z. May.
Counts of red tide organisms, Gymnodinium breve, and associated oceanographic data from Florida west coast, 1957-59. 4321
Duke, T. Ward, D. W. Hood, and B. Stevenson.
Measurement of toxicity of organic wastes of marine organisms. 4414
Dumas, Richard F.
Effect of light, diet, and age of spawning brown trout upon certain characteristics of their eggs and fry. 4347
Dunbar, C. E., Ken Wolf, and E. A. Pyle.
Infectious pancreatic necrosis of trout. II. Experimental infections with brook trout. 4238

Eddy, Samuel, and Thaddeus Surber.
Northern fishes. With special reference to the upper Mississippi valley. 4387
Ellis, Robert W., Albert Rosen, and Alan W. Moffett.
A survey of the number of anglers and of their fishing effort and expenditures in the coastal recreational fishery of Florida. 4325
Engstrom, Kjell.
Cone types and cone arrangement in the retina of some cyprinids. 4404

Farrugia-fougerouse, Gisele.
Contribution to the knowledge of the origin, of the metabolism, and some biological properties, for

algae, of the mineral salts and organic compounds dissolved in bodies of natural standing water. (Contribution a la connaissance de l'origine, du metabolism, et des proprietes biologiques, pour les algues, des sels mineraux et composes organique dissous dans les collections d'eau naturelles stagnantes.) 4371

Favorite, Felix.
Surface temperature and salinity off the Washington and British Columbia coasts, August, 1958 and 1959. 4311

Finucane, John H., Alexander Dragovich, and Billie Z. May.
Counts of red tide organisms, Gymnodinium breve, and associated oceanographic data from Florida west coast, 1957-59. 4321

Flora, Charles J.
The species commonality index: a method for comparing habits. 4273

French, R. R., and R. J. Wahle.
Salmon runs - upper Columbia River, 1956-57. 4300

Gard, Richard, and Paul R. Needham.
Rainbow trout in Mexico and California. 4364

Gasowska, Matylda.
Genus Coregonus L. discussed in connection with a new systematic feature,that of shape and proportion of os maxillare and os supramaxillare (Polish and Russian summ.). 4408

Geen, G. H., and F. J. Andrew.
Sockeye and pink salmon production in relation to proposed dams in the Fraser River system. 4360

Goodnight, C. J., and L. S. Whitley.
Oligochaetes as indicators of pollution. 4435

Graham, Joseph J., and James W. McGary.
Biological and oceanographic observations in the central north Pacific July-September 1958. 4319

Gray, I. E., Mary Jane Wells, and Harry W. Wells.
Winter fish mortality in Pamlico Sound, North Carolina. 4241

Greeley, John R., Norman G. Benson, Melvin I. Huish, and Jerome H. Kuehn.
Status of Management of Natural Lakes. 4338

Green, H. B., and Ross E. Hutchins.
Laboratory study of toxicity of imported fire ants to bluegill fish. 4362

Grenier, F.
A constant flow apparatus for toxicity experiments on fish. 4390

Grømtved, Jul.
Taxonomical and productional investigations in shallow coastal waters. 4385

Gulland, J. A., R. J. H. Beverton, and A. R. Margetts.
Whiting tagging: how the tag return is affected by the condition of fish when tagged. 4415

Gulland, J. A., S. J. Holt, C. Taylor, and S. Kurita.
A standard terminology and notation for fishery dynamics. 4359

Gunter, Gordon, L. L. Sulya, and B. E. Box.
Plasma proteins in the blood of fishes from the Gulf of Mexico. 4374
Distribution of some blood constituents in fishes from the Gulf of Mexico. 4418

Halver, John E., and Warren E. Shanks.
Nutrition of salmonoid fishes. VIII. Indispensable amino acids for sockeye salmon. 4338

Hartman, Richard T., and Craig L. Himes.
Phytoplankton from Pymatuning Reservoir in downstream areas of the Shenango River. 4272

Hasler, Arthur D., and Donald C. McNaught.
Surface schooling and feeding behavior in the white bass, Roccus chrysops (Rafinesque), in Lake Mendota. 4261

Hatch, Richard W., and Dwight A. Webster.
Trout production in four central Adirondack Mountain lakes. 4344

Heard, William R.
The use of hobbled gill nets in a commercial fishery of Lake Carl Blackwell, Oklahoma. 4232

Hennemuth, Richard C.
Size and year class composition of catch, age and growth of yellowfin tuna in the eastern tropical Pacific Ocean for the years 1954-1958. 4271

Herke, William H.
Comparison of the length-weight relationship of several species of fish from two different but connected habitats. 4286

Hester, F. Eugene.
The tolerance of eight species of warm-water fishes to certain rotenone formulations. 4292
The toxicity of Noxfish and Pro-noxfish to eggs of common carp and fathead minnows. 4293

Hevly, Richard H., and Charles T. Mason, Jr.
Additions to the aquatic flora of Arizona. 4423

Himes, Craig L., and Richard T. Hartman.
Phytoplankton from Pymatuning Reservoir in downstream areas of the Shenango River. 4272

Hitz, C. R.
Occurrence of two species of juvenile rockfish in Queen Charlotte Sound. 4308

Hoffman, Glenn Lyle.
Whirling disease (Myxosporidia:Myxosoma) of trout. 4244

Holt, S. J., J. A. Gulland, C. Taylor, and S. Kurita.
A standard terminology and notation for fishery dynamics. 4358

Hood, D. W., T. Ward Duke, and B. Stevenson.
Measurement of toxicity of organic wastes of marine organisms. 4414

Houston, Arthur H.
Influence of size upon the adaptation of steelhead trout, Salmo gairdneri, and chum salmon, Oncorhynchus keta to sea water. 4315

Hrbacek, J., and M. Hrbackova-Esslova.
Fish stock as a protective agent in the occurrence of slow-developing dwarf species and strains of the genus Daphnia. 4392

Hrbackova-Esslova, M., and J. Hrbacek.
Fish stock as a protective agent in the occurrence of slow-developing dwarf species and strains of the genus Daphnia. 4392

Huish, Melvin, Norman G. Benson, John R. Greeley,

and Jerome H. Kuehn.
Status of management of natural lakes. 4338
Hutchins, Ross E., and H. B. Green.
Laboratory study of toxicity of imported fire ants to bluegill fish. 4362

Isabel, W. Smith.
A disease of finnock due to Vibrio anguillarum. 4372
Isom, B. G.
Toxicity of elemental phosphorus. 4437
Ivlev, V. S.
On the utilization of food by planktophage fishes. 4410

Job, S. V.
Growth and calorific approximation in the speckled trout. 4383
Johnson, A. K.
Ichthyophthiriasis is a recirculating closed-water hatchery. 4270
Jones, R. O., and J. R. Snow.
Some effects of lime applications to warm-water hatchery ponds. 4234
Joseph, Edwin B., William H. Massmann, and John J. Norcross.
Investigations of inner continental shelf waters off lower Chesapeake Bay. Part I.--General introduction and hydrography. 4352

Kawamoto, N. Y.
The influence of excretory substances of fishes on their own growth. 4266
Keleher, J. J.
Comparison of largest Great Slave Lake fish with North American records. 4316
Kelley, Don W., and Almo J. Cordone.
The influences of inorganic sediment on the aquatic life of streams. 4351
Kelly, William H., and Howard A. Loeb.
Laboratory manufacture of fish baits for experimental purposes. 4348
Kendall, James I.
In vivo staining of calcified tissues of sharks. 4422
Ketchen, K. S., and R. M. Wilson.
A new record of the long-finned cod, Antimora rostrata Gunther, from British Columbia waters. 4309
Klawe, W. L.
Young scombroids from the waters between Cape Hatteras and Bahama Islands. 4269
Klement, A. W., Jr., and I. E. Wallen.
A selected list of references of marine and aquatic radiobiology. 4369
Knapp, Robert J., and Thomas F. Waters.
An improved stream bottom fauna sampler. 4339
Knopp, H.
The role of phytoplankton in oxygenation conditions in rivers. 4428
Koblenz-Mishke, O. J.
On the study of primary production in the sea by Soviet scientists. 4394
Kodama, Yasuo.
Studies on the specific growth of fresh-water fishes referring to the weight increase of individual and population--III. Growth of the pond-reared ayu-fish, Plecoglossus altivelis T. and S., with special reference to the significance of their social behaviour in eliminating the possible growth-improving effect of feeding by many food-balls. 4268
Krau, L., L. P. H. Oliveira, R. Nascimento, and A. Miranda.
Hydrobiological observation on fish mortality in the lagoon of Camorim. 4436
Krause, H. R.
The decomposition of organic phosphorus components from dead fresh-water zooplankton. 4429
Kuehn, Jerome H., Norman G. Benson, John R. Greeley, and Melvin I. Huish.
Status of Management of Natural Lakes. 4338
Kuehne, Robert A., and Reeve M. Bailey.
Stream capture and the distribution of the percid fish Etheostoma sagitta, with geologic and taxonomic considerations. 4267
Kurita, S., S. J. Holt, J. A. Gulland, and C. Taylor.
A standard terminology and notation for fishery dynamics. 4359

Lambou, Victor W.
Use of machine methods in processing fishery data. 4283
Larsen, Howard N., and S. F. Snieszko.
Modification of the microhematocrit technique with trout blood. 4329
Larsen, Knud.
The fish population of a peat pit as determined by rotenone poisoning. 4386
Lawler, G. H.
Egg counts of Lake Erie whitefish. 4310
Lebedeva, G. B.
The accumulation of cerium-144 by year-old carp and water thyme. 4434
Lecal, J.
Experimental research on the Blennidae of Castiglione. (Recherches experimentales sur les Blennides de Castiglione.) 4400
Lennon, Robert E.
A fly-rod electrode system for electrofishing. 4265
Liebmann, H.
The influence of sewages on fisheries. 4426
Limbaugh, Conrad.
Life-history and ecologic notes on the black croaker. 4349
Loeb, Howard A., and William H. Kelly.
Laboratory manufacture of fish baits for experimental purposes. 4348
Lotan, Ruth.
Adaptability of Tilapia nilotica to various saline conditions. 4264

McCarraher, D. B.
Extension of the range of northern pike, Esox lucius. 4341

McCrimmon, H. R., and A. H. Berst.
An analysis of sixty-five years of fishing in a trout pond unit. 4262
McGary, James W., and Joseph J. Graham.
Biological and oceanographic observations in the central north Pacific July-September 1958. 4319
McKenzie, R. A., and S. N. Tibbo.
Herring movements in the Bay of Fundy and Gulf of Maine, 1957 and 1958. 4305
McNaught, Donald C., and Arthur D. Hasler.
Surface schooling and feeding behavior in the white bass, Roccus chrysops (Rafinesque), in Lake Mendota. 4261
Magnin, E., and G. Beaulieu.
Movements of tagged sturgeons in the Saint Lawrence River. (Deplacements des esturgeons (Acipenser fulvescens et A. oxyrhynchus) du fleuve Saint-Laurent d'apres les donnees du marquage.) 4363
Mansueti, Romeo.
Comments on the need for critical fishery research planning and electronic data processing. 4291
Mansueti, Romeo J.
Restriction of very young red drum, Sciaenops ocellata, to shallow estuarine waters of Chesapeake Bay during late autumn. 4357
Mantelman, I. I.
Distribution of the young of certain species of fish in temperature gradients. 4381
Margalef, Ramon.
Ideas for a synthetic approach to the ecology of running waters. 4402
Margetts, A. R., R. J. H. Beverton, and J. A. Gulland.
Whiting tagging: how the tag return is affected by the condition of fish when tagged. 4415
Markowski, S.
Observations on the response of some benthonic organisms to power station cooling water. 4263
Mason, Charles T., jr., and Richard H. Hevly.
Additions to the aquatic flora of Arizona. 4423
Massmann, William H., Edwin B. Joseph, and John J. Norcross.
Investigations of inner continental shelf waters off lower Chesapeake Bay. Part I. General introduction and hydrography. 4352
May, Billie Z., Alexander Dragovich, and John H. Finucane.
Counts of red tide organisms, Gymnodinium breve, and associated oceanographic data from Florida west coast, 1957-59. 4321
Menasveta, Deb., and Lauren R. Donaldson
Selective breeding of chinook salmon. 4332
Miranda, A., L. P. H. Oliveira, R. Nascimento, and L. Krau.
Hydrobiological observation on fish mortality in the lagoon of Camorim. 4436
Moav, Rom.
An electric instrument for brandmarking fish. 4260
Moffett, Alan W., Albert Rosen, and Robert W. Ellis.
A survey of the number of anglers and of their fishing effort and expenditures in the coastal recreational fishery of Florida. 4325
Muller, W.
Untersuchungen uber die Machwirkung einer im Vorjahn Gegebenen Phosphatdungung in Teichen. 4259

Nascimento, R., L. P. H. Oliveira, L. Krau, and A. Miranda.
Hydrobiological observation on fish mortality in the lagoon of Camorim. 4436
Needham, James G.
Culture methods for invertebrate animals. 4391
Needham, Paul R., and Richard Gard.
Rainbow trout in Mexico and California. 4364
Nichols, Paul R.
Homing tendency of American shad, Alosa sapidissima, in the York River, Virginia. 4355
Nigrelli, Ross F.
Fatty degeneration, regenerative hyperplasia and neoplasia in the livers of rainbow trout, Salmo gairdneri. 4258
Nigrelli, Ross F., and Morris H. Baslow.
Muscle acetylcholinesterase levels as an index of general activity in fishes. 4280
Norcross, John J., Edwin B. Joseph, and William H. Massmann.
Investigations of inner continental shelf waters off lower Chesapeake Bay. Part I. General introduction and hydrography. 4352

Ohsawa, Wataru, and Hiroko Tsukada.
The heat and cold temperatures in Lebistes reticulatus as determined by raising and lowering water temperature at constant rates. 4376
Oliva, Ota.
Further contribution to the fish populations composition in Middle Bohemia. (D Alsi Prispevek K Poznani Slozeni Rybich Populaei V Polabi.) 4257
Oliveira, L. P. H., R. Nascimento, L. Krau, and A. Miranda.
Hydrobiological observation on fish mortality in the lagoon of Camorim. 4436
Olivereau, Madeleine.
A volumetric study of the anterior interrenal gland during the migration of Salmo salar L. (Etude Volumetrique de l'interrenal anterieur au cours de la smoltification de Salmo salar L.) 4375
Olsen, A. M., and D. Vaux.
Use of drift bottles in fisheries research. 4242
O'Rourke, Fergus J.
Presence of blood antigens in fish mucus and its possible parasitological significance. 4256

Pearce, William A.
The upper St. Lawrence River ice fishery. 4345
Perlmutter, Alfred.
Possible effect of lethal visible light on year-class fluctuations of aquatic animals. 4255
Peters, Hans M.
On the relationship between egg number and egg

weight in fish. (Uber die beziehungen Zwischen eizahl und eigewicht bei fischen.) 4397

Phillips, Arthur M., Jr.
Effect of water temperature and diet on the blood glucose of brook trout. 4253

Piavis, George W.
Embryological stages in the sea lamprey and effects of temperature on development. 4322

Pierce, Phillip, W. W. Thomaston and Herbert N. Wyatt.
Experimental use of silvex and other aquatic herbicides in Georgia farm ponds. 4284

Pimentel, David.
Animal population regulation by the genetic feed-back mechanism. 4254

Pinkas, Leo.
Descriptions of postlarval and juvenile bonito from the eastern Pacific Ocean. 4350

Poole, John C.
Age and growth of the fluke in Great South Bay and their significance to the sport fishery. 4346

Pop, V.
Contribution to the study of the dorsal eyes in Lampetra (Eudontomyzon) danfordi Regan (Cyclostomata, Petromyzones). (Contributii la studiul ochilor dorsali la Lampetra (Eudontomyzon) danfordi Regan (Cyclostomata, Petromyzones).) 4403

Pore, Arthur.
Chesapeake Bay hurricane surges. 4353

Prather, E. E.
The use of channel catfish as sport fish. 4288

Press, Judith S., M. A. Ali, and W. R. Stevenson.
Histophysiological studies on the juvenile Atlantic salmon Salmo salar retina. I. Rates of light - and dark - adaptation. 4282

Purkett, Charles A., Jr.
Reproduction and early development of the paddlefish. 4327

Pycha, Richard L., and Lloyd L. Smith, Jr.
Factors related to commercial production of the walleye in Red Lakes, Minnesota. 4337

Pyle, E. A., Ken Wolf, and C. E. Dunbar.
Infectious pancreatic necrosis of trout. II. Experimental infections with brook trout. 4238

Radovich, John.
Relationships of some marine organisms of the northeast Pacific to water temperatures, particularly during 1957 through 1959.

Randall, John E.
A contribution to the biology of the convict surgeon-fish of the Hawaiian Island, Acanthurus triostegus sandvicensis. 4250

Rawson, D. S.
The lake trout of Lac La Ronge, Saskatchewan. 4317

Reish, Donald J.
A study of benthic fauna in a recently constructed boat harbor in southern California. 4252

Riedl, Rupert.
A kinemeter for the observation of dredges at any depth. (Ein kinemeter zur beobachtung von dredgen in beliebigen tiefen.) 4401

Robertson, O. H.
Prolongation of the life span of kokanee salmon (Oncorhynchus nerka Kennerlyi) by castration before beginning of gonad development. 4249

Robson, D. S., and D. G. Chapman.
Catch curves and mortality rates. 4336

Rosen, Albert, Robert W. Ellis, and Alan W. Moffett.
A survey of the number of anglers and of their fishing effort and expenditures in the coastal recreational fishery of Florida. 4325

Rupp, Robert S.
Measurement of potential fishing quality. 4333

Saddler, James Bryan, and Laurence Marvin Ashley.
Comparative histology of the pyloric caeca of certain teleost fish. 4405

Sano, Osamu.
The investigation of salmon shark as a predator on salmon in the North Pacific, 1959. 4236

Scarratt, D. J.
A pressurizing device for a camera case designed for use in shallow water. 4235

Schwartz, Frank J.
Bibliography of Maryland fisheries, including published and unpublished papers on the fisheries and related fields of tidewater Maryland. 4248
Measurements and the occurrence of young sandbar shark, Carcharhinus milberti, in Chesapeake Bay, Maryland. 4356
Recent additions to the upper Chesapeake Bay fish fauna. 4358

Scott, D. P.
Radioactive iron as a fish mark. 4313

Sen, D. N., and U. N. Chatterji.
A study on the aquatic plant community at Gorakhpur in relation to the pH of the medium. 4411

Shanks, Warren E., and John E. Halver.
Nutrition of salmonoid fishes. VIII. Indispensable amino acids for sockeye salmon. 4388

Shanks, W. E., W. T. Yasutake, and D. R. Buhler.
Chemotherapy of hexamitiasis in fish. 4237

Sheridan, William L.
Temperature relationships in a pink salmon stream in Alaska. 4247

Shine, Lee, Sam L. Clark, Moon Yong Chung, and Margaret R. Clark.
Responses in free swimming fishes to electrical stimulation of the cerebellum. 4389

Silvey, J. K. G.
Physical, chemical and biologic effects of hexadecanol of Lake Hefner, 1958. 4430

Smith, Lloyd L., Jr., and Richard L. Pycha.
Factors related to commercial production of the walleye in Red Lakes, Minnesota. 4337

Smith, M. W.
A limnological reconnaissance of a Nova Scotian brown-water lake. 4318

Snieszko, S. F., and Howard N. Larsen.
Modification of the microhematocrit technique with trout blood. 4329

Snow, J. R., and R. O. Jones.
Some effects of lime applications to warm-water hatchery ponds. 4234
Srivastava, Vinay K.
Studies on fresh water bottom fauna. III. The correlation between bottom fauna and the food of fishes. 4373
Stepanek, M., R. Cervenka, and M. Votavova.
Limnological study of the reservoir Sedlice near Zeliv. VII. A contribution to the technique of selecting new algicide compounds. 4433
Stevens, Robert E.
The white and channel catfishes of the Santee-Cooper Reservoir and Tailrace Sanctuary. 4233
Stevenson, B., D. W. Hood, and T. Ward Duke.
Measurement of toxicity of organic wastes of marine organisms. 4414
Stevenson, W. R., M. A. Ali, and Judith S. Press.
Histophysiological studies on the juvenile Atlantic salmon Salmo salar retina. I. Rates of light - and dark - adaptation. 4282
Stevenson, W. R., M. A. Ali, and P. Coper.
Correlation of morphological and intra-ocular measurements in the Atlantic salmon, Salmo salar, yearling. 4379
Strong, Dorothy H., Ruth E. Baldwin, and James H. Torrie.
Flavor and aroma of fish taken from four fresh-water sources. 4335
Sulya, L. L., B. E. Box, and Gordon Gunter.
Plasma proteins in the blood of fishes from the Gulf of Mexico. 4374
Distribution of some blood constituents in fishes from the Gulf of Mexico. 4418
Sundnes, G.
Another modification of the Scholander-Roughton technique: Nitrogen determination in fish blood. 4365
Surber, Eugene W.
Suggested standard methods of reporting fish population data for reservoirs. 4285
Surber, Thaddeus, and Samuel Eddy.
Northern fishes. With special reference to the upper Mississippi valley. 4387
Sylvester, R. O., and R. H. Bogan.
Pesticides and lake rehabilitation. 4427

Tanoue, Toyotake.
Studies on the relation between the fluctuation in catch and the environmental factors of the principal fishes in Kagoshima Bay. --IV. On the young horse-mackerel, Trachurus japonicus. 4246
Tash, Jerry C., and Kenneth B. Armitage.
A seasonal survey of the vertical movements of some zooplankters in Leavenworth County State Lake, Kansas. 4245
Taylor, C., S. J. Holt, J. A. Gulland, and S. Kurita.
A standard terminology and notation for fishery dynamics. 4359
Tebo, L. B., Jr.
Comparison of fish populations in polluted and non-polluted arms of a warm-water reservoir. 4289
Tesch, F. W., and M. L. Albrecht.
Fishery-biological investigations in flowing waters. II. The Ilm. 4425
Thomaston, W. W., Phillip C. Pierce, and Herbert N. Wyatt.
Experimental use of silvex and other aquatic herbicides in Georgia farm ponds. 4284
Thrailkill, James R.
Zooplankton volumes off the Pacific coast, 1958. 4324
Tibbo, S. N., and R. A. McKenzie.
Herring movements in the Bay of Fundy and Gulf of Maine, 1957 and 1958. 4305
Torrie, James H., Ruth E. Baldwin, and Dorothy H. Strong.
Flavor and aroma of fish taken from four fresh-water sources. 4335
Tsukuda, Hiroko, and Wataru Ohsawa.
The heat and cold coma temperatures in Lebistes reticulatus as determined by raising and lowering water temperature at constant rates. 4376

Uchida, Richard N.
Hermaphroditic skipjack. 4243

Van Oosten, John.
Records, ages, and growth of the mooneye, Hiodon tergisus, of the Great Lakes. 4334
Van Someren, V. D., and P. J. Whitehead.
The culture of Tilapia nigra (Gunther) in ponds. II. The influence of water depth and turbidity on the growth of male T. nigra. 4366
The culture of Tilapia nigra (Gunther) in ponds. III. The early growth of males and females at comparable stocking rates, and the length/weight relationship. 4367
The culture of Tilapia nigra (Gunther) in ponds. IV. The seasonal growth of male T. nigra. 4368
Vanstone, W. E., and F. Chung-Wai Ho.
Plasma proteins of coho salmon, Oncorhynchus kisutch, as separated by zone electrophoresis. 4314
Vaux, D., and A. M. Olsen.
Use of drift bottles in fisheries research. 4242
Votavova, M., R. Cervenka, and M. Stepanek.
Limnological study of the reservoir Sedlice near Zeliv. VII. A contribution to the technique of selecting new algicide compounds. 4433

Wachek, F.
The problem of the permissible pollution load on flowing waters. 4431
Waffle, Elizabeth L., Philip T. Clampitt, and Richard V. Bovbjerg.
An ecological reconnaissance of the bottom fauna, Millers Bay, Lake West Okoboji. 4370
Wahle, R. J., and R. R. French.
Salmon runs - upper Columbia River, 1956-57. 4300
Waite, Dixon, and Keen Buss.
Research units for egg incubation and fingerling rearing in fish hatcheries and laboratories. 4278

Walburg, Charles H.
Natural mortality of American shad. 4342
Wallen, I. E., and A. W. Klement, Jr.
A selected list of references of marine and aquatic radiobiology. 4369
Waters, Thomas F., and Robert J. Knapp.
An improved stream bottom fauna sampler. 4339
Webster, Dwight A., and Richard W. Hatch.
Trout production in four central Adirondack Mountain lakes, 4344
Weiss, Charles M.
Physiological effect of organic phosphorus insecticides on several species of fish. 4330
Wells, Harry W., Mary Jane Wells, and I. E. Gray.
Winter fish mortality in Pamlico Sound, North Carolina. 4241
Wells, Mary Jane, Harry W. Wells, and I. E. Gray.
Winter fish mortality in Pamlico Sound, North Carolina. 4241
Westlake, D. F.
Water weed and water management. 4424
Whitehead, P. J., and V. D. van Someren.
The culture of Tilapia nigra (Gunther) in ponds. II. The influence of water depth and turbidity on the growth of male T. nigra. 4366
The culture of Tilapia nigra (Gunther) in ponds. III. The early growth of males and females at comparable stocking rates, and the length/weight relationship. 4367
The culture of Tilapia nigra (Gunther) in ponds. IV. The seasonal growth of male T. nigra. 4368
Whitley, L. S., and C. J. Goodnight.
Oligochaetes as indicators of pollution. 4435
Whitney, Richard R., and Kenneth D. Carlander.
Age and growth of walleyes in Clear Lake, Iowa, 1935-1957. 4328
Williams, F.
On Scomberomorus lineolatus (C. V.) 1831, from British East African waters (Pisces, scombridae). 4378
Wilson, R. M., and K. S. Ketchen.
A new record of the long-finned cod, Antimora rostrata Gunther, from British Columbia waters. 4309
Wise, John P.
The world's southernmost indigenous cod. 4416
Witt, Arthur, Jr.
An improved instrument to section bones for age and growth determinations of fish. 4240
Wittenberg, Beatrice A., and Jonathan B. Wittenberg.
The secretion of oxygen into the swim-bladder of fish. II. The simultaneous transport of carbon monoxide and oxygen. 4420
Wittenberg, Jonathan B.
The secretion of oxygen into the swim-bladder of fish. I. The transport of molecular oxygen. 4419
Wittenberg, Jonathan B., and Beatrice A. Wittenberg.
The secretion of oxygen into the swim-bladder of fish. II. The simultaneous transport of carbon monoxide and oxygen. 4420
Wohlschlag, Donald E.
Growth of an Antarctic fish at freezing temperatures. 4239
Wolf, Ken, C. E. Dunbar, and E. A. Pyle.
Infectious pancreatic necrosis of trout. II. Experimental infections with brook trout. 4238
Wood, E. M.
Definitive diagnosis of fish mortalities. 4417
Wuhrmann, K.
Concerning some principles of the toxicology of fish. 4384
Wunder, W.
Implantation into the musculature and body cavity of fishes of foreign bodies made from plastics and other materials. Investigations on carp. (Einpflanzung von fremdkorpern aus kunststoffen und anderem in die muskulatur und in die leibeshohle von fischen. Versuche an karpfen (Cyprinus carpio L.).) 4399
Wurtz, Charles B., and Colton H. Bridges.
A study of the effects of increased temperatures on biochemical oxygen demand. 4395
Wyatt, Herbert N., W. W. Thomaston, and Phillip C. Pierce.
Experimental use of silvex and other aquatic herbicides in Georgia farm ponds. 4284

Yamagami, Kenjiro.
Phosphorus metabolism in fish eggs. II. Transfer of some phosphorus compounds from egg yolk into embryonic tissues in Salmo irideus during development. 4421
Yasutake, W. T., D. R. Buhler, and W. E. Shanks.
Chemotherapy of hexamitiasis in fish. 4237

Zahnd, J. P., and J. Clavert.
Histological modifications of the liver in the females of some species of teleosts during vitellogenesis which occurs during the great increase of the ovocytes. (Modifications histologiques du foie des femelles de quelques especes de teleosteens au cours de la vitellogenese de grand accroissement des ovocytes.) 4398
Zhadin, V. I.
The international limnological congress, 19 Aug. 1959. XIV Mezhdunarodnyi limnologicheskii kongress, 19 Aug. 1959. 4306

++++++++++++++++++++++++++

## SUBJECT INDEX


Acanthurus triostegus, life history, 4250
Acipenser
  fulvescens (see sturgeon, lake)
  oxyrhynchus (see sturgeon, Atlantic)
Age and growth,
  ayu, 4268
  bones, sectioner, 4240
  fish
    excretion influence, 4266
    length-weight relation, 4286
  fluke, 4346
  mooneye, 4334
  records, Great Slave Lake, 4316
  salmon, Kokanee, 4249
  Tilapia nigra, 4366, 4367, 4368
  Trematomus bernacchii, 4239
  trout,
    brook, 4344, 4383
    rainbow, 4344
  tuna, yellowfin, 4271
  walleye, 4328, 4337, 4343
Alosa sapidissima (see shad, American)
Anatomy,
  eyes, Lampetra danfordi, 4403
  inter-ocular measurement, Atlantic salmon, 4379
  liver, fish, 4398
  morphology, rainbow trout, 4364
  os maxilare, Coregonus, 4408
  os supramarilare, Coregonus, 4408
  pyloric caeca, teleosts, 4405
  retinal cones, Cyprinids, 4404
  swimbladder,
    fish, 4419
    toadfish, oyster, 4420
  Weberian ossicles, Catostomid, 4412
Antimora rostrata, distribution, 4309
Ayu, growth, 4268

Bass,
  largemouth, length-weight relation, 4286
  white, food habits, 4261
Benthos,
  boat harbor, 4252
  fish food, correlation, 4373
  Lake Erie, 4331
  Lake West Okoboji, Iowa, 4370
  response, cooling water, power station, 4263
  sampler, stream, 4339
Bibliography,
  fisheries, 4248, 4294, 4296, 4298
  limnology, 4297
  radiobiology, 4369
Biocides,
  algicides, selection, 4433
  fire ants, bluegill, 4362
  herbicides, silvex, 4284
  insecticides,
    organic phosphorus, 4330
    various, 4427
  piscicides,
    noxfish, 4293
Biocides, cont.
  piscicides, cont.
    pronoxfish, 4293
    rotenone, 4292, 4386
Blennidae,
  growth, 4400
  morphology, 4400
Bluegill,
  fertilization, pond, 4234
  length-weight relation, 4286
  toxicity,
    fire ants, 4362
    phosphorus, 4437
Bonito, Pacific, identification, 4350
Buffalo, culture, 4290
Butterfish, races, 4299

Compostoma anomalum (see stoneroller)
Caranx mate, life history, 4409
Carcharhinus milberti (see shark, sandbar)
Carp,
  branding, 4260
  Cerium$^{144}$, accumulation, 4434
  eggs, piscicide, 4293
  flavor and aroma, 4335
  tagging, 4399
Catfish,
  channel,
    tailwaters, 4233
    sport fish, economics, 4288
  white, tailwaters, 4233
Cheilotrema saturnum (see croaker, black)
Chemical factors,
  B. O. D., temperature influence, 4395
  D. O., Lake Erie, 4331
  hydrogen sulfide, lagoon, 4436
  organic phosphorus, zooplankton, 4429
  oxygenation, phytoplankton, 4428
  pH, aquatic plants, 4411
  salinity,
    fish, 4276
    Tilapia nilotica, 4264
Clupea harengus harengus (see herring, Atlantic)
Cod, Atlantic,
  distribution, 4416
  taxonomy, 4377
Competition,
  Daphnia, strains, 4392
  rainbow trout-redside shiner, 4304
Coregonus
  clupeaformis (see whitefish, lake)
  taxonomy, 4408
Croaker, black, life history, 4349
Culture,
  bluegill, pond fertilization, 4234
  buffalo fish, 4290
  cod, Atlantic, 4361
  fish,
    egg incubation, 4278
    fingerling rearing, 4278
  invertebrates, 4391
  salmon, chinook, selective breeding, 4332
  Tilapia

Culture, cont.
Tilapia, cont.
esculenta, 4407
nigra, 4366, 4367, 4368
Cyprinidae, retinal cones, 4404
Cyprinus carpio (see carp)

Darter, arrow,
distribution, 4267
taxonomy, 4267
Diet,
salmon, sockeye, amino acids, 4388
trout,
brook, blood glucose, 4253
brown, eggs and fry, 4347
Disease,
diagnosis, fish, 4417
hexamitiases, chemotherapy, 4237
Ichthyophthiriasis, trout, 4270
infectious pancreatic necrosis, brook trout, 4238
kidney, brook trout, 4281
liver, rainbow trout, 4258
therapy, fish baits, 4348
vibrio, brown trout, 4372
whirling, skipjack tuna, 4244
Distribution,
Antimora rostrata, 4309
cod, Atlantic, 4416
darter, arrow, 4267
fish,
Chesapeake Bay, 4358
marine, South Carolina, 4277
pike, northern, 4341
rockfish,
copper, 4308
tiger, 4308
Scombroids, young, 4269
shark, sandbar, 4356
stoneroller, 4406
Drugs, anesthetic, sockeye salmon, 4340
Drum, red, distribution, 4357

Ecology,
benthos, lake, 4370
croaker, black, 4349
plankton, marine, 4393
species commonality index, 4273
streams, 4402
Economics,
catfish, channel, sport, 4288
marine fishery, Florida, 4325
Passamaquoddy Project, 4302
recreation, streams, 4287
Electricity,
response, fish, cerebellum, 4389
shocker,
fly rod electrode, 4265
lamprey ammocoetes, 4279
Embryology,
lamprey, sea, 4322
toadfish, oyster, 4354
Equipment,
branding, carp, 4260
camera case, pressurized, 4235
capillary tubes, trout blood, 4329
drift bottles, currents, 4242
electrode, fly rod, 4265
kinemeter, dredges, 4401
machine,
fish baits, 4348
fishery data, 4283, 4291
Mariotte bottle, toxicity tests, 4390
nets, gill, commercial, 4232
sampler, benthos, 4339
sectioner, bone, 4240
shocker, back-pack, 4279
Esox
lucius (see pike, northern)
niger (see pickerel, chain)
Etheostoma sagitta (see darter, arrow)
Euthynnus pelamis (see tuna, skipjack)

Fertilization, ponds,
lime, 4234
phosphate, 4259
Flounder, summer, age and growth, 4346
Food habits,
bass, white, 4261
Caranx mate, 4409
fish, benthos, 4373
Megalaspis cordyla, 4409

Gadus morhua (see cod, Atlantic)
Genetics, population regulation, "feed-back," 4254
Gymnodinium breve (see red tide)

Haemulon, taxonomy, 4274
Harvest,
catch curves, mortality, 4336
catfish, channel, 4288
fish,
coastal, Florida, 4325
commercial, gill nets, 4232
ice fishing, 4345
quality, measurement, 4333
Solea solea, 4380
Trachurus japonicus, 4246
trout, pond, 4262
tuna, yellowfin, 4271
walleye, commercial, 4337
Herring, Atlantic, movements, 4305
Hiodon tergisus (see mooneye)

Ictalurus
catus (see catfish, white)
punctatus (see catfish, channel)
Identification,
bonito, Pacific, 4350
fish, Upper Mississippi River, 4387
Haemulon, 4274
rockfish,
copper, 4308
tiger, 4308

Lamma ditropis (see shark, salmon)
Lampetra danfordi, dorsal eyes, 4403

Lamprey, sea,
embryology, 4322
shocker, back-pack, 4279
Lebistes reticulatus,
tail regeneration, 4413
temperature tolerance, 4376
Lepomis
machrochirus (see bluegill)
macrolophus (see sunfish, redear)
Life history,
Acanthurus triostegus, 4250
Caranx mate, 4409
croaker, black, 4349
Megalaspis cordyla, 4409
trout, lake, 4317
yellowtail, 4326
Limnology,
bibliography, 4295
Congress, Austria, 4306
lake, brown-water, 4318

Management, natural lakes, 4338
Megalaspis cordyla, life history, 4409
Micropterus salmoides (see bass, largemouth)
Migration and movement,
bass, white, 4261
drum, red, 4357
fish, young, thermal gradients, 4381
herring, 4305
salmon, Pacific, 4300
shad, American, 4355
sturgeon,
Atlantic, 4363
lake, 4363
zooplankton, vertical, 4245
Minnow, fathead, eggs, piscicide, 4293
Mooneye, age and growth, 4334

Oceanography,
Atlantic, South, 4301
bibliography, 4297
Chesapeake Bay, 4352
Gulf of Mexico, Florida Coast, 4321
Naples, Florida, 4323
Pacific,
central north, 4319
Washington and British Columbia, 4311
Passamaquoddy Region, 4302, 4303
Oncorhynchus
gorbuscha (see salmon, pink)
keta (see salmon, chum)
kisutch (see salmon, coho)
nerka (see salmon, sockeye)
tschawytscha (see salmon, chinook)
Opsanus tau (see toadfish, oyster)

Paddlefish,
development, 4327
reproduction, 4327
Pantosteus plebeins (see sucker, Rio Grande)
Paralichthys dentatus (see flounder, summer)
Parasites, mucus, species specific antigens, 4256
Petromyzon marinus (see lamprey, sea)
Physical factors,
currents,
drift bottles, 4242
plankton, 4275
evaporation, hexadecanol, 4430
light,
salmon, Atlantic, 4282
trout,
eggs, 4255
brown, 4347
morphology, Great Lakes, 4307
sediment, organisms, 4351
surges, hurricane, 4353
temperature,
benthos, power cooling water, 4263
B. O. D. 4395
fish,
catch fluctuations, 4246
distribution, 4381
growth, 4239
lagoon, 4276
mortality, 4241
lamprey, sea, 4322
organisms, marine, 4251
salmon, pink, 4247
Tilapia, 4366
trout, brook, 4253
turbidity, Tilapia, 4366
various, Lake Erie, 4331
Physiology,
calcium deposition, fish, 4422
carbon dioxide, secretion, swimbladder, 4420
circulatory,
blood antigens, mucus, fish, 4256
constituents, fish, 4418
glucose, brook trout, 4253
microhematocrit, trout, 4329
nitrogen determination, 4365
plasma proteins,
fish, 4374
salmon, coho, 4314
coma, temperature, fish, 4376
excretory,
fish growth, 4266
interrenal gland, Atlantic salmon, 4375
metabolism, fish planktophagic, 4410
muscle acetylcholinesterase, fish, 4280
nervous,
electrical stimulation, fish, 4389
phosphorus insecticides, fish, 4330
osmoregulation,
salmon, chum, 4315
trout, rainbow, 4315
oxygen, secretion, swimbladder, 4419, 4420
phosphorus, egg, fish, 4421
respiration,
M. S. 222, sockeye salmon, 4340
trout, brook, 4383
tail regeneration, 4413
Pickerel, chain, length-weight relation, 4286
Pike, northern,
distribution, 4341
flavor and aroma, 4335
Pimephales promelas (see minnow, fathead)

Plankton,
abundance, Naples, Florida, 4323
gross production, 4385
marine,
ecology, 4393
toxicity, pollution, 4414
phyto-,
oxygenation, 4428
ponds, 4371
reservoir, 4272
zoo-,
Daphnia, predation, 4392
movement, lake, 4245
organic phosphorus, 4429
Pacific Coast, 4324
water movements, lake, 4275
Plecoglossus altivelis (see ayu)
Pollution,
apparatus, toxicity tests, fish, 4390
aquatic weeds, importance, 4424
indicators, oligochaetes, 4435
load, streams, 4431
mercuric chloride, fish, 4382
mortality, diagnosis, fish, 4417
organic, toxicity, marine organisms, 4414
pesticides, toxicity, 4426
phenylmercuric acetate, fish, 4382
phosphorus, toxicity, 4437
rehabilitation, lakes, 4432
reservoir, fish, population, 4289
sewage, stream, 4425
various,
flavor and aroma, fish, 4335
toxicity, fish, 4384
Polyodon spathula (see paddlefish)
Populations,
animal, regulation, genetics, 4254
biota, Lake Erie, 4331
butterfish, races, 4299
fish,
peat pit, 4386
reservoir,
control, 4257
polluted, 4289
reporting, 4285
salmon,
pink, 4312, 4360
sockeye, 4360
Solea solea, North Sea, 4380
trout,
lakes, 4344
rainbow, 4364
Porontus triacanthus (see butterfish)
Predation,
Daphnia, fish, 4392
salmon, Pacific, salmon shark, 4236
Production, primary,
coastal waters, 4385
sea, Soviet, 4394

Radiology,
bibliography, 4369
$C^{14}$, primary production, 4394
$Ce^{144}$, carp, accumulation, 4434
Radiology, cont.
marking, brook trout, 4313
Red tide, Florida, west coast, 4321
Rehabilitation, reservoir, rotenone, 4257
Reproduction,
fish, eggs,
number and weight, 4397
piscicides, 4293
paddlefish, 4327
salmon, pink, aerial counts, 4312
Scombroids, Atlantic, 4269
Solea solea, North Sea, 4380
Teleosts, vitellogenesis, 4398
trout,
eggs, light, 4255
brown, eggs and fry, 4347
rainbow, eggs, 4421
whitefish, lake, fecundity, 4310
Research,
egg incubation, fish, 4278
fingerling rearing, 4278
fisheries,
drift bottles, 4242
electronic data processing, 4291
needs, 4338
Passamaquoddy Project, 4302
water milfoil, 4320
Richardsonius balteatus (see shiner, redside)
Roccus chrysops (see bass, white)
Rockfish,
copper, distribution, 4308
tiger, distribution, 4308

Salmo
clarki (see trout, cutthroat)
gairdneri (see trout, rainbow)
salar (see salmon, Atlantic)
trutta (see trout, brown)
Salmon,
Atlantic,
interrenal gland, 4375
morphology, 4379
retina, 4282
chinook,
breeding, selective, 4332
hexamitiasis, 4237
runs, Columbia River, 4300
chum, osmoregulation, 4315
coho,
ichthyophthiriasis, 4270
plasma proteins, 4314
Pacific, predation, shark, 4236
pink,
populations, dams, 4360
spawning, aerial counts, 4312
stream, temperatures, 4247
sockeye,
amino acids, 4388
castration, life span, 4249
oxygen consumption, M.S. 222, 4340
populations, dams, 4360
runs, Columbia River, 4300
Salvelinus
fontinalis (see trout, brook)

Salvelinus, cont.
namaycush (see trout, lake)
Sarda chiliensis (see bonito, Pacific)
Sciaenops ocellata (see drum, red)
Scomberomorus lineolatus, taxonomy, 4378
Scombrids, spawning, Atlantic, 4269
Sebastodes
caurinus (see rockfish, copper)
nigrocinctus (see rockfish, tiger)
Seriola dorsalis (see yellowtail)
Shad, American,
homing, 4355
natural mortality, 4342
Shark,
salmon, predation, 4236
sandbar, young, Chesapeake Bay, 4356
Shiner, redside, competition, trout, 4304
Solea solea, stocks, North Sea, 4380
Stizostedion vitreum (see walleye)
Stocking and introduction,
ayu, rates, 4268
catfish, channel, ponds, 4288
Tilapia nigra, ponds, 4367
trout,
brook, disease, 4281
brown, Natal, 4396
rainbow, Natal, 4396
Stoneroller, distribution, 4406
Sturgeon,
Atlantic, movement, 4363
lake, movement, 4363
Sucker, Rio Grande, Weberian ossicles, 4412
Sunfish, redear, length-weight relation, 4286
Survival,
fish,
estimation, catch curves, 4336
winter, Pamlico Sound, 4241
shad, American, natural, 4342
Tilapia nilotica, salinity, 4264

Tagging and marking,
branding, carp, 4260
methods, whiting, 4415
plastics, carp, 4399
radioactive iron, brook trout, 4313
Taxonomy,
butterfish, 4299
cod, Atlantic, 4377
Coregonus, 4408
darter, arrow, 4267
fish, Upper Mississippi River, 4387
Haemulon, 4274
Scomberomorus lineolatus, 4378
Terminology, fishery dynamics, 4359
Thunnus albacores (see tuna, yellowfin)
Tilapia
esculenta, diet, 4407
mossambica, eggs, 4397
nigra, culture, 4366, 4367, 4368
nilotica, osmoregulation, 4264
Toadfish, oyster, larval development, 4354
Trachurus japonicus, harvest, 4246
Trematomus bernacchii, growth, 4239
Trout,
Trout, cont.
brook, cont.
blood glucose, 4253
disease,
infectious pancreatic necrosis, 4238
kidney, 4281
eggs, light, lethal, 4255
marking, radioactive iron, 4313
oxygen consumption, 4383
pond, harvest, 4262
production, lakes, 4344
brown,
disease, vibrio, 4372
eggs and fry, 4347
introduction, Natal, 4396
cutthroat, ichthyophthiriasis, 4270
disease, whirling, 4244
lake, life history, 4317
rainbow,
competition, redside shiner, 4304
disease,
ichthyophthiriasis, 4270
liver, 4258
eggs,
light, lethal, 4255
phosphorus metabolism, 4421
introduction, Natal, 4396
osmoregulation, 4315
populations, races, 4364
production, lakes, 4344
Tuna,
skipjack, hermaphroditic, 4243
yel'owfin,
age and growth, 4271
harvest, 4271

Vegetation,
aquatic,
distribution, Arizona, 4423
pH, water, 4411
pollution, 4424
water milfoil, Chesapeake Bay, 4320

Walleye,
age and growth, 4328, 4343
flavor and aroma, 4335
harvest, commercial, 4337
Water developments,
boat harbor, dredged, benthos, 4252
dam,
salmon, pink, 4360
salmon, sockeye, 4360
power,
bay, fisheries, 4302, 4303
station, cooling water, benthos, 4263
reservoir,
catfish,
channel, 4233
white, 4233
downstream, phytoplankton, 4272
evaporation, hexadecanol, 4430
limnology, 4433
pollution, fish, 4289
populations, fish, 4257, 4285

Water developments, cont.
reservoir, cont.
zooplankton, 4245
steam plant, temperature, fish, 4395
Whitefish, lake, fecundity, 4310
Whiting, tagging, returns, 4415
Yellowtail, life history, 4326

**********

ABSTRACTORS OTHER THAN AUTHORS AND STAFF

Lucie Arvy
G. R. Bernard
Biological Abstracts
C. S. I. R. O. Abstracts
C. C. Davis
R. R. Dexter
R. P. Elliott
D. E. Ferguson
Isaiah Gellman
G. Gunter
K. E. Marshall
C. T. Mason
L. Z. McFarland
M. B. Pieper
A. Pigon
M. C. Redin
Water Pollution Abstracts

**********

INT.DUP.,D.C.61-103222

FISH
RESTORATION